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NATURAL HISTORY

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THE

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JANUARY, 1882.

I. THE LAW OF EVOLUTION: IS IT GENERAL?

THE truth of Evolution as a primary law of the Universe must to a great extent turn on its generality. If we see traces of its action—not demonstrable, but merely probable—in each class of phenomena which we successively examine, the difficulties in the way of its acceptance will be very much lessened. Now we find it beyond all dispute in the growth of the individual animal or vegetable from the germ to maturity. We say "beyond dispute," though we know a somewhat eccentric thinker who maintains that this development is an illusion, and that the infant, the boy, the youth, and the man are not four successive stages of one and the same being, but four distinct beings which succeed each other. Whether he puts forward this strange speculation as a mere dialectical exercise, or as a *reductio ad absurdum* of the hypothesis of separate creation, we have never been able to feel satisfied.

To return: we recognise Evolution, then, in the individual, in the nation, and in human society at large. In the animal and vegetable world we see good cause to accept it as the probable method in which those forms we call species have originated. Passing on to the other extremity of the scale, Evolution, as opposed to individual appearance, seems generally received as the process by which the heavenly bodies have taken their rise. It is not for this purpose necessary that we should accept the "nebular hypothesis," the cosmogony of Kant and La Place, and deduce suns and planets from the gradual condensation of a fire mist. The obvious difficulties which beset this hypothesis need not, as modern astronomers have shown, compel us to the old doctrines of eternal existence or of mechanical contract-work.

But between the vital and the astronomical lies a very important region, to which, in the opinion of many men of Science, the doctrines of Evolution are inapplicable. We refer to the region of chemical phenomena. If this vast and important sphere shows no signs of the operations of Evolution,—still more if it gives proof of their absence,—then we have to do not with any universal principle, but with a possibly exceptional agency. We shall have no *à priori* right for assuming its presence and intervention where not fully demonstrated.

We turn first to the so-called chemical elements, and ask what is their origin? Have they been developed, as we suppose animal and vegetable species to have been, from a few kinds of primordial matter, or even from one kind only? Have they existed from all eternity as the raw materials of the universe, capable of being associated chemically into compounds and mechanically into aggregates, varying in bulk and importance from the dust-grain to the star? Or have they been called into existence independently of each other, whether by some external power—self-conscious or otherwise—or by some unknown impulse inherent in matter? To none of these questions does Science return a definite answer; she offers us probabilities, indeed, but not certainties. The physicist is able to tell us that suns and earths, as such, cannot have existed for ever; they have had a beginning, and must have an end. The universe, think some, is one huge grave-yard for dead stars. But all this throws no light upon the origin of the chemical elements. Certain metals, gases, and the like exist in the Sun, in Sirius, or in Vega; but this does not tell us whether the same particles of matter first sprang into existence with the orbs they help to constitute, or whether they have previously been present in stars now no longer in existence. The chemist tells us that neither by the aid of the spectroscope nor yet by the analysis of meteoric stones which arrive from the depths of space can he find indications of any other kinds of matter than the sixty odd elements which are met with in our own planet. But this conclusion, however interesting in itself, is of no direct use for our present purpose. Assuming it is proved that the whole universe is built up of these sixty, we must pronounce that assumption equally consistent with the hypothesis of eternal existence, of special origin (creation in a mechanical sense), or of evolution.

The decomposition of any of the supposed elements and their resolution into simpler primitive forms of matter, would of course have been decisive; but this decomposition has not been effected. The experiments of Profs. Victor and Carl Meyer on the vapour-densities of the halogens at high temperatures, and the spectroscopic observations of Mr. Norman Lockyer on the sun and on certain of the more brilliant stars, have given rise to hopes. But all of the results obtained admit of other interpretations than that of the decomposition or approaching decomposition of an elementary body. It must, indeed, be admitted that the prospect of such a decomposition is not becoming stronger. If we consider the legions of chemists who are at work in the present day, and the improved resources at their command, we cannot avoid a suspicion that if the compound nature of the elements were capable of experimental demonstration some definite advance towards that end would have been already made.

We must therefore search for indirect evidence. Here, then, we find not a few circumstances which militate, apparently at least, against evolution and continuity. We see, in chemical phenomena, as Mr. Baildon has ably pointed out, not gradual serial change, but abrupt transition. The various elements do not pass into each other by imperceptible changes, but, with few exceptions, they display well-marked contrasts. No one can assert that, like organic species and varieties, they differ merely subjectively. We have not in chemistry, as in botany or zoology, contests between "lumpers" and "splitters" as to the number of distinct forms in existence.

Again, if we study what takes place in the act of chemical combination, we find no gradual passage through intermediate stages. We may have, *a*, a mixture of oxygen and hydrogen, and *b*, water, formed by the combination of these two elements. But no one has detected any intermediate phase, any transition between fully-formed water and its constituents. Chemical compounds—those, at least, of a lower order—pass through no embryonic condition.

It may even be asked whether the law of combination in certain fixed proportions, and in their multiples only, is in harmony with the fundamental ideas of evolution and continuity? We have just seen that in the genesis of water Nature does act *per saltum*, and the same holds good with other bodies of a similar rank.

But we trace in the chemical region other considerations which tell very strongly in favour of evolution. We find among the elements certain which are exceedingly abundant, such as aluminium, silicon, iron, oxygen, sodium, &c.: others comparatively rare, such as indium, vanadium, thallium, iridium, &c. How is this? On the hypothesis of primordial existence such a distinction is not easily to be explained. On the evolutionary view it may be fairly contended that the circumstances under which the rarer elements have been produced may have been of unfrequent occurrence as compared with those under which the common simple bodies were developed. To the objection that we never find any elementary substances changing their nature, or reverting into the primordial state of matter,—an objection which reminds us of the cavil that we never see a man reverting to an ape,—it may be replied that under given conditions matter has reached forms which are stable, and that none of the original "raw material" remains. We may here refer to the view expressed by the late Prof. Clerk Maxwell, and by Sir John Herschell, that the elementary atoms bear the impress of a "manufactured article." But every manufactured article presupposes an original material. Thus this hypothesis agrees in its requirements with the evolutionist view, and the impossibility of producing a specimen of the "raw material" is of little weight against either.

But let us now suppose some sixty kinds of elemental bodies, some of them more and some of them less plentiful, either co-existing from all eternity or called into independent existence. Were all these bodies indifferent to each other the probability is surely that the atoms of each kind would be distributed with approximate uniformity, regard only being had to their relative abundance. If, as is actually the case, they are not indifferent, but have those various tendencies to combine together which are commonly called affinities, we should find those bodies accumulated together which have the strongest affinities for each other, whilst those which have but feeble mutual affinities, or substantially none, would be found mutually apart. Now as a general rule it may be asserted that those elements which have strong affinities for each other are at the same time such as differ widely in their properties, and that, on the contrary, such as approximate closely in their properties have little mutual affinity. But if we examine into the composition of the earth, the rocks, and the waters, we very commonly find bodies associated together which are very similar to each other, and which have very feeble mutual affinities. To take a very common case, we find in the waters of the sea, of certain lakes, and springs, the three true halogens—chlorine bromine, and iodine—associated together, the two latter always in exceedingly minute proportions as compared with the former. Now these three substances have such very doubtful affinities for each other that, if primordially existing or created separately, we cannot reasonably suppose them becoming grouped together as they now occur. But if they have been developed from some common primary material, or if bromine and iodine are transformation-products of chlorine, their joint occurrence is what we should naturally expect. Or, again, we may take the case of nickel and cobalt. These metals, as a rule, accompany each other in Nature. Wherefore? The teleologist has nothing to urge; for even if we grant that man is the object and measure of all things, we remember that these two metals and their respective combinations are rendered of much less value to man by being mixed up together. It may be said that the very considerable similarity of these two metals in their physical and chemical properties opposes every natural agency for their separation, just as it obstructs and delays the analyst and the metallurgist in the same operation. We grant the difficulty of separating them when once in association; but what should first bring into such general juxtaposition two kinds of bodies, not over-abundant, if there has ever been a grand game of hide and seek played by the elements? But on the supposition of development the case is easily understood. There are other groups of elements which in like manner are met with together in Nature, and which certainly do not manifest any especial mutual attraction. Thus there are the platinum metals, and — most striking case of all—those recently discovered elements which have been obtained from samarskite. These bodies are not only exceedingly rare, and confined to a very few localities (as regards chemical elements the particular rock or mineral in which they occur seems to take the place of the *habitat* of organic species), but they differ so slightly in their properties that we cannot help regarding them as varieties formed by a process of development.

The periodic law of Prof. Mendelejeff, to which successive researches seem to give confirmation, can scarcely be interpreted as otherwise than in favour of the evolution of the elements from some common fundamental material. If primordially existing it seems to us that the probability of regular relations being detected among them would be exceedingly trifling. Nor do such relations* become at all more probable if regarded from a teleological point of view.

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* Journal of Science, 1877, p. 291.

But if we look at a table of the elements, and consider their properties, we can scarcely fail to be reminded of the features presented by a group of organic forms. In such a group—say in a large genus of insects—we find a few species common, numerous, and well-marked. We then see a number of others comparatively scarce, or indeed very rare. Among these rare species we find several which are difficult to distinguish from each other, and we often trace sub-groups inhabiting the same district, and having an especially strong family likeness. We find species standing widely apart from each other, and between which some connecting-link seems either to have disappeared or to have escaped notice, and others again so closely similar that the discovery of any further allied species would be felt as an inconvenience. Again, if we try to arrange animal forms in any regular series, according as they depart gradually from some given type, we proceed for a while very satisfactorily; but before long we come to a species which seems equally well entitled to two or even more positions.

If a digression is here permissible we may ask whether something like periodicity does not obtain in the organic world, and whether an indistinct recognition of this principle —overlaid indeed with assumptions and errors in abundance —was not the grain of truth hidden in the "quinarian" or representative system of Macleay, Swainson, and their allies? Naturalists who consider that species, like individuals, are evolved not at haphazard, but in certain given directions, will perhaps see here a clue to an advance in taxonomy.*

But to return: these very features which we have just traced—say in the Coleopterous genus *Aphodius*—may be in the main recognised in our table of chemical elements. Here, again, we find a few common species and many rare ones, the latter generally clinging together, being often difficult to discriminate, and inhabiting some special geological formation or some mineral species, just as a zoological subgenus is found in some island like Macassar or Madagascar. We do not, indeed, find among the elements any two whose distinct nature remains for a length of time doubtful. But we come upon difficulties of classification very similar to those encountered in the organic world, aberrant and anomalous members which have not been fully reduced to order even by the periodic classification.

We have pointed out the abruptness of chemical combination and the sudden and complete change which ensues when elementary bodies unite together to form some compound; but it may, even in this respect, be submitted that what in the simpler inorganic bodies appears so discontinuous is greatly modified in the higher organic compounds. In such bodies as water, ammonia, the anhydrides, the metallic oxides, &c., we find two elements only present, a single atom of one of these being united to one, two, three, or perhaps four of the other, forming distinct stages between which there is nothing intermediate. But in organic compounds the combining weight of each element has often to be multiplied by some very high number, and thus the series becomes continuous, the law of definite proportions notwithstanding. We have said above that the lower inorganic kind of chemical compounds have no embryonic intermediate state. But as the higher organic compounds appear to be formed not by the union of distinct and simple atoms, but of groups of atoms which are in themselves compound, it may be asked whether these proximate constituents do not in some degree stand in the stead of an embryonic state?

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* We shall probably, by opportunity, resume this question.

We have referred to the absence of an intermediate stage in such cases as the formation of water; but the study of living bodies supplies us with a transformation no less sudden. Matter is either living or lifeless; there is no intermediate third stage. A particle of lifeless inorganic matter brought into contact, under certain circumstances, with the organised body flashes into life. The "merorganic" stage of certain chemists and physiologists of the second quarter of the present century is no longer recognisable. Comparing, then, the two pictures, the table of the elements, and the general features of chemical phenomena, on the one hand, and on the other the ranks of the organic kingdoms and the laws of vital phenomena, we see no such decided distinction as would forbid us from pronouncing the former as situate altogether outside the scope of the law of Evolution. And if we pass from the simple elements to their compounds actually existing upon the earth, we find that the analogy becomes closer,—that we may even trace some of the workings of the principle of Natural Selection. This will appear as follows:—The elements have, we believe, varying tendencies to combine among themselves, just as organisms have inborn tendencies to modification in certain directions. These tendencies are, however, exerted under varying conditions of temperature, pressure, mutual proportion, access or non-access of air and moisture, and presence or absence in each case of substances capable of interfering or modifying the result. Hence among the compounds formed those which are in harmony with surrounding conditions are preserved, whilst those not in such harmony are decomposed and give place for others. Thus the struggle for existence is being waged among mineral bodies, governed by purely chemical and physical forces as it is among animals and plants, where, in addition, we recognise an unknown agency which we call "life." Whether this life is merely a modification of the ordinary chemical and physical energies working under a new set of conditions, or whether it is a totally distinct kind of energy, or whether, lastly, it is due to the presence in the plant and the animal of some immaterial power, is for our present purpose beside the question.

It appears, then, that chemical phenomena do not present a region within which the great principle of Evolution does not hold good. That it acts—necessarily acts—here in a manner different in some respects from what is observed in the organic world need not perplex us, if we do not insist upon pushing too far the analogies between dead matter and living, growing, reproductive organisms, whose existence is not linear and of undeterminate extent, but cyclical or periodic.

II. DISUNION IN THE CAMP.

IN opposing a fanatical movement such as the Anti-Vivisection agitation there can be surely no doubt as to the absolute necessity for union among the friends of Science. We must be agreed as to our position and our demands, and there must be no attempts to make terms with the utterly irrational and irreconcilable enemy before us. Our position is this: that if it be justifiable to inflict pain and death upon animals for gain, for amusement, for convenience, for food, or for self-defence, it is, to say the least, equally justifiable to inflict pain and death in pursuit of knowledge. Our demands are the entire and unconditional repeal of the Vivisection Act, and the concession of the same freedom of action to the biologist as he formerly enjoyed, and as is now possessed by the chemist and the physicist. If we take up any lower ground,—if we accept any compromise, any circumscribed liberty trammelled with the interference of an un-scientific or possibly anti-scientific Home Secretary, we open the gates to the enemy, and must not be surprised if he takes full advantage of our weakness. We must not forget that the hysterical party have lately boasted of apparent wavering among medical men as ominous of "the beginning of the end." It is accordingly with feelings of the most profound regret that we have read, in the "Medical Press and Circular," the report of a lecture delivered before the Halifax Literary and Philosophical Society, by Mr. T. M. Dolan, F.R.C.S. (Ed.) The subject of the lecture was "The Practical Value of Recent Research on Micro-Organisms." Referring, towards the close of his address, to the Vivisection question, the lecturer is reported as having said :—

"I should like to take this opportunity of disabusing your minds about the practice, and to ask you to consider this question rationally. I shall not say a word to hurt the most ardent anti-vivisectionist. (1st) Cruelty to animals is abhorred by medical men ; I need not tell you I allude to unnecessary cruelty. (2nd) Experiments on animals are only made by scientific skilled physiologists ; nearly all animals experimented on are rendered insensible by curare. (3rd) All we ask for is that our tried and trusted physiologists and surgeons should be allowed, under a certificate, to conduct those experiments which they may deem necessary, without the harassing and annoying conditions which are almost prohibitory, and which are fatal to the advance of physiology. I know we have English talent in the physiological department of medicine, equal to any foreign talent, undeveloped, however, owing to the discouragement it receives. I would ask you to consider the present condition of the profession in England, and if you desire the advance of English medicine, to strengthen the hands of those who are advancing it, by your moral support.

"To torture a living animal, under the pretence of research, deserves condemnation : no language is too strong to use against such iniquity. Let the Act stand in force against such dabblers in Science ; with a tenfold greater severity even than at present, let its punishment be increased, but let us discriminate. Pasteur, with all his honours thick upon him, loved, revered, with family ties, and everything that can bind him to life, goes calmly down to the foulsome Lazaretto, to try and find out the cause of yellow fever, to stamp it out as he stamped out silk-worm disease. He goes with his life in his hand to slay disease. Colville and Payne (Englishmen) went to Astrakan to study the plague; they went forth nobly, as medical men should go, to confront the plague in its home. They exposed their lives, and I am convinced that the humblest member in my profession is so imbued with its traditions, so educated, that whether it be the cholera, the plague, or typhus he has to encounter when called in, he will be at his post, faithful unto death. It is for those unselfish men, for Brunton, Frazer, Lister, Sanderson, Greenfield, Ewart, I ask your sympathy and support; for the leaders in medicine, who are striving in this prosaic weary work-a-day world, like the knights of old, to overcome the powers that surround us, the hidden, unseen, impalpable agents of disease and death, to bring them into subjection to laws of health, to benefit you and posterity."

Let us examine this passage. There is first the promise "not to hurt the most ardent anti-vivisectionists." We may here well ask, what are their claims to such tender treatment? Is it because they have been considerate of the feelings of men of Science? Few agitators have dealt more liberally in the foulest abuse than have the leaders of this humanitarian movement. The motives, the characters, and the reputations of men, living or dead, who are known to have experimented upon live animals, have been vilified without scruple. Where the constituted authorities have refused to be swayed by clamour, our enemies have not hesitated to appeal to popular violence, as when the Physiological Institute of the University of Leipzig was stormed and ravaged by an anti-vivisectionist mob.

Or has the hysterical party merited especial consideration by the integrity and chivalrous candour they have shown? We are well aware that fanatics of all grades have somewhat confused notions of the distinction between truth and falsehood. But the anti-vivisectionists have in this respect outdone the bulk of agitators. Both in England and on the Continent they have not scrupled to represent Mr. Darwin as having expressed himself in their favour, although he distinctly says, in his letter to Prof. Holmgren, "I know that Physiology cannot possibly progress except by means of experiments upon living animals, and I feel the deepest conviction that he who retards the progress of Physiology commits a crime against mankind."

Again, at one time letters appeared in the "Standard," and we believe in other papers also, complaining that young art students in our public galleries were worried into signing petitions for further restrictions on physiological research. These statements were from eye-witnesses. An eminent artist informed us that his daughter had been beset in like manner whilst copying a painting. Yet in the face of this direct positive evidence the secretary of one of the anti-visectionist societies actually wrote to deny these assertions, and trusted that the editor's "sense of fairness" would allow this contradiction to appear! We ask, How can any man truthfully contradict an account of any occurrence except he himself had been present?

Again, there appeared advertisements in different papers headed with the name of one of the anti-vivisection societies. Immediately under this heading came a list of eminent physicians and other scientific men. Any person merely glancing at the advertisement would receive the impression that these gentlemen were in some way connected with the Anti-Vivisection movement. On close examination it appeared that they were the Committee for the erection of the monument in honour of the illustrious Harvey. The purport of the advertisement was to deny, or at least to detract from, the merits of Harvey as the discoverer of the circulation of the blood. But why were the names of the Committee introduced? We have certainly no right to declare that they were inserted with the intention of deceiving the public; but we submit that men careful to avoid even the appearance of evil, and anxious not to be misunderstood, would never have placed such names in such a connection.

One more instance may serve to complete our estimate of the spirit in which this crusade against Science is being waged. According to the report in the "Daily Telegraph"—"A public meeting was held at Willis's Rooms 'to discuss the moral right and true philosophy of painfully experimenting upon animals for scientific purposes.' The president of the Society for the Abolition of Vivisection (the Rev. C. W. Grove) occupied the chair, and stated that the object of the meeting was to invite physiologists, biologists, and members of the medical profession to state their views on the subject of vivisection. It was desirable to hear both sides of the question, and to know the results of the vivisection experiments which had been made. The chairman then invited medical gentlemen to express their views. Dr. Nicholls, Dr. Walker, and other speakers condemned vivisection, and stated that they did not know of a single instance of benefit accruing to the human race as the result of vivisection experiments." So this "discussion"—this "hearing both sides of the question"—amounted to harangues from partizans, who, if legally qualified medical practitioners, have scant right to come forward as the representatives of the profession, and still scantier claim to speak on behalf of Science.

It is further interesting to mark the motives underlying no small portion of anti-vivisectionist enthusiasm. The movement, like all agitations, ministers to the vanity of not a few individuals, and enables them to gain the ear and the favouring notice of a certain section of the public. Moreover, the competitive element, so dearly loved in modern England, is not wanting. There are several societies for the suppression of Vivisection, all in full accord as far as enmity to biological research is concerned, but jealous of each other touching the *kudos*, or the more tangible rewards to be earned. In our collection of Anti-Vivisectionist literature we find such advertisements as the following:—

"The Society has no connection with any other. The public is cautioned against persons pirating its publications, and endeavouring without any authority to obtain money."

"One of the new Societies was set on foot in the hope of supplanting the original Society and appropriating its funds by an intrigue, but the attempt was defeated. It has also pirated our publications, and we are now endeavouring to obtain legal redress. We think the public should be informed of these facts, and warned against *professional humanitarians and social parasites*, who, as is too often the case, try to obtain celebrity or to live and fatten by any humane enterprise. Like the Seigneur Manuel Ordonez, in Gil Blas, they become rich in managing the affairs of the poor." This truthful and damaging exposure of the character of the movement bears the signature of one of its most vehement champions!

Or, lastly, does Mr. Dolan wish to spare the feelings of the Anti-Vivisectionists in the hope of conciliating or disarming their hostility? It is poor policy, we would remind him, to run away from a fanatic, a lunatic, or a mad bull. He merely gathers courage from the timidity of his adversary. The present Vivisection Act was an attempt at conciliation. Its result has been merely an intensification and extension of the uproar it was intended to pacify. Are the Anti-Vivisectionists really worthy of such consideration as Mr. Dolan proposes to show them?

But to proceed: the lecturer tells us that "Cruelty to animals is abhorred by medical men: I need not tell you I allude to unnecessary cruelty." But if we define cruelty s the wanton and needless infliction of pain and death, and specially the taking pleasure in such infliction, the very notion of "unnecessary cruelty" disappears. That which s necessary is not cruel. No one has yet had the impudence to contend that vivisectionists, whether they be medical practitioners or not, derive any gratification from heir operations. To give pain for mere amusement, or for he exercise and display of skill, is something we leave to he sportsman !

Again, we read—"Experiments are only made by scienific* skilled physiologists." This is a mere truism ; persons ther than scientific physiologists have no inducements to make such experiments. But we can scarcely see the relevance of this contention as against the Anti-Vivisectionists. This, however, is a matter of small moment.

We pass on to Mr. Dolan's demands, which are most unsatisfactory. "All we ask for is that our tried and trusted physiologists and surgeons should be allowed, under a certificate, to conduct those experiments which they may deem necessary, without the harassing and annoying conditions which are almost prohibitory, and which are fatal to the advance of Physiology." Mr. Dolan, therefore, if faithfully eported, accepts the principle of the Vivisection Act, interpreted perhaps in a somewhat more liberal spirit than is now he case. He consents that experimentation upon animals hould be restricted to "tried and trusty physiologists and surgeons," under the further limitation of a "certificate." Let us see what these admissions involve. We submit hat—

1st. He places the medical profession in an exceptional and humiliating position. Both law and public opinion allow persons, often ignorant, coarse, and brutal, to perform painful operations upon animals, so long as those operations are not to promote the advance of Science. Those who take animal life for the purposes of food, those who castrate young animals, those who massacre seals in the Arctic regions to provide jackets for lady Anti-Vivisectionists, &c., do not equire any certificate from the Home Office, nor does any one ask if their skill and experience are such as to minimise he suffering inflicted. Yet we venture to assert that the seal-hunt in a single season occasions a greater amount of orture to unoffending animals than Vivisectionists have nflicted for a century. Or, if a man applies to the Revenue officials for a gun- and a sporting-license, no question is raised whether he is so efficient a marksman as to kill outright and not maim the birds he fires at. Surely to give all these classes of people full scope for action in their dealings with animals, and to single out the medical profession for inspection and "certificates" is a gross insult. Yet, according to Mr. Dolan, the perpetuation of this insult is "all we ask for"!

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* Are there any non-scientific physiologists?

2nd. If certificates for experimentation are to be granted only to those who are "tried and trusted," the young, and those who have not already earned a sufficiently high reputation, will find themselves necessarily excluded. This will prove a most unfortunate restriction for the advancement of Physiology. It is universally conceded that the mind is most suggestive—most fruitful in novel ideas—in the earlier portion of life. If a biologist is to be debarred from working out and testing his ideas experimentally till he is a man of established reputation, very much important work will perforce remain undone. What would be the position of chemistry or of physics if the student must obtain a certificate before entering upon original research?

3rd. Unless we misunderstand him, Mr. Dolan completely ignores non-medical biologists. There are numbers of scientific men who in their researches into the phenomena of organic life—especially among the lower animals—find it necessary to have recourse to experiments which a sentimentalist might think fit to proclaim as painful. True such inquiries are often beyond the grasp of the present Vivisection Act, which does not include the Invertebrata in its provisions, but our fanatical party are clamorous for its extension. Chemists, also, in toxicological cases before the passing of the Act, often found it useful to administer some substance isolated from the body of a poisoned person to an animal, as a proof of its nature. Thus the most sensitive test for strychnine is a frog. But in England this test is no longer available. There is no time to wait for the various formalities, and no certainty that when all have been duly gone through the license will be granted.

Mr. Dolan's line of action, in confining his remarks to the needs of medical men, is the more strange since no small part of his lecture is devoted to an exposition of the researches of M. Pasteur. Now M. Pasteur is no surgeon, no medical practitioner. He is a chemist, formerly a pupil and assistant of Prof. Dumas, and when he first attacked the silkworm disease it was objected to him that he was no physiologist. Yet his experiments on the propagation of zymotic disease and on its counteraction have required vivisection,—not, indeed, "cutting animals up alive," as vivisection is defined when it is desired to harrow up the public mind, but still operations which in England would lay him open to prosecution. Now, except we can secure something more than the "all" which Mr. Dolan asks for, an English Pasteur would, we think, find himself shut out.

But the Lecturer continues in a style almost worthy of the author of the "British Dog," of Miss Cobbe, or of W. Howitt:—"To torture a living animal under the pretence of research deserves condemnation; no language is too strong to use against such iniquity!" We ask Mr. Dolan whether any such cases really occur, or have occurred? Those who take a pleasure in cruelty know well that "research" is the most unsafe "pretence" they could put forward. Let them only plead "sport," or a wager, then, if the victim is a wild animal, they may either escape punishment altogether, or at most incur a fine of a few shillings. That wanton cruelty is abundant, rampant, in this country we admit, but it is not inflicted in the service of Science. Unless Mr. Dolan knows as a fact, capable of being proved to the satisfaction of a Court, that such torture under "pretence of research" does occur, he has been exceedingly ill-advised in using the language which we have quoted. He must, on reflection, feel that by so doing he has played into the hands of the enemy, who will quote his remarks as the admissions of a defender of vivisection. He goes on, however:—"Let the Act stand in force against such dabblers in Science, with a tenfold greater severity even than at present; let its punishment be increased, but let us discriminate." Here Mr. Dolan somewhat changes his point of view. In the last sentence he was dealing, as we understand, with persons who make a mere "pretence" of Science. But a "dabbler" is something different from a "pretender," and we should like to see his definition of the former term. Is it a person outside the pale of the medical profession? Or one—medical or non-medical—who has not yet acquired celebrity? Or is it some person whose skill is questionable, or whose object in experimentation is not sufficiently definite? These are points which it will be difficult to decide fairly, and which, so long as the miserable Act stands, will always be cropping up. Vivisection is troublesome, expensive, and every way unpleasant, and we cannot conceive of any person having recourse to it as an amusement, or if he sees any other way of solving the problems before him. But why even a bungling vivisector should be punished so much more severely than a cock-fighter, or than the other classes of persons who indulge in utterly wanton inflictions of pain, it might be difficult for Mr. Dolan to show. We have no doubt that the intentions of this gentleman were excellent, but we fear that he has gravely compromised the movement which must now be made to stay the march of fanaticism. The naturalists of England are, we believe, fully prepared to stand shoulder to shoulder with the medical profession, but they cannot consent to any line of defence by which they would be abandoned.

III. PHRENOLOGY AND ANIMAL PSYCHOLOGY.

By J. W. Slater.

IT is well known that a feud exists between the naturalists and the metaphysicians, or, as they prefer to call themselves, philosophers, on the subject of animal psychology. The latter gravely decide on *à priori* principles, or indeed sometimes assume without any grounds at all that "mere brutes" cannot lay claim to some particular faculty of the mind. The naturalists, on the other hand, true to their training, allow themselves to be guided by facts. If they observe in any animal the manifestations of a certain faculty or sentiment, they at once admit its presence and do not seek to evade the issue by cunningly drawn definitions proposed for the very purpose of creating a "great gulf" between man and his "poor relations." Hence it may be suspected that metaphysical subtlety is rather a hindrance than an aid in the study of the animal mind.

Now it is somewhat singular that the phrenology of Gall, Spurzheim, and Combe, though in many respects hostile to the psychology of the metaphysical schools, entered into an alliance with them by assenting to the assumption of a distinction *toto cœlo* between "man" and "brute." This view the phrenologists expressed in their arrangement of the "sentiments." They proposed one class as "common to man with the lower animals," and another as "proper to man." Under the former head they placed "self esteem, love of approbation, cautiousness, and benevolence." Under the latter they included "veneration, firmness, conscientiousness, hope, wonder, ideality, wit, and imitation." From this classification certain corollaries would follow, *e.g.*, that all animals, man excepted, differ little mentally among themselves, and that if on the phrenological theory each faculty of the mind has its seat in some especial portion of the brain, then a whole region of the brain present in man must be absent in the anthropoid apes, which would establish a very striking difference at once recognised by the anatomist.

In the very incomplete state of our knowledge of animal psychology, it may not be useless to examine whether the sentiments assumed by phrenologists as peculiar to man are really and truly absent in the rest of the animal creation. For our purpose it will not be necessary to enquire whether these sentiments are in their nature simple and elementary, or whether any of them may result from the interaction of other primitive faculties.

We will begin at the end of the catalogue. Have the lower animals the desire to imitate the actions, manners, and gestures of other animals or of man? Affirmative instances are so common and obvious that we cannot well understand how the question can be raised by any person in possession of eye-sight. Imitation is as decidedly a leading or misleading propensity of animals as of men. It is distinctly prominent among sheep and monkeys, with the difference that a sheep only copies the actions of another sheep, whilst the so-called Quadrumana will very cleverly imitate the conduct of such human beings as they have the opportunity of observing—a characteristic not recurring with equal distinctness in any other mammalian group. I know no instance of a dog or a cat being led to eat any unusual substance through seeing its master partake thereof. I have, however, witnessed two distinct cases of imitation on the part of cats. A daughter of mine was waving a sheet of paper up and down in front of a fire to dry it, when a favourite kitten which was sitting on the hearth and intently watching, waved its right fore paw up and down in the very same manner. On another occasion a young cat sitting on a flight of steps, watched a charwoman who was cleaning the flags of the area below. To my surprise the cat began to work its fore-paw round and round, imitating the rotatory movements of the woman's arm.

When a body of hunters dash through a pasture-field where cattle are grazing, the latter have been know to join in the chase and clear hedges and ditches in a style little in keeping with their usual sobriety of demeanour.

Wit is another of the sentiments assumed as peculiar to man. Of course, as we do not understand the language of any of the lower animals we cannot show that they indulge in humorous remarks. But it may be fairly assumed that a sense of the ridiculous, a comprehension of the nature of ridicule are causally connected with the sentiment of wit, so that where the former are present the latter cannot be altogether absent. Now certain animals are sensitive to ridicule and are greatly annoyed and offended if laughed at. That this is the case with dogs many persons know from their own observations. For the benefit of others I quote an instance narrated by Mr. G. J. Romanes, in "Nature," May 27th, 1875. A certain terrier "used to be very fond of catching flies upon the window-panes, and if ridiculed when unsuccessful was very much annoyed. On one occasion, in order to see what he would do, I purposely laughed immoderately every time he failed. It so happened that he did so several times in succession—partly, I believe, in consequence of my laughing—and evidently he became so much distressed that he positively pretended to catch the fly."

It may here, of course, be contended that dogs by constant companionship with man, may have acquired feelings or sentiments not natural to the lower animals. To this objection I give my usual reply; if circumstances can create in a dog or other animal some sentiment entirely new, then the presence or absence of any mental feature is utterly inadequate to establish a distinction of kind between man and beast. But the same feeling is shown by monkeys, born in a wild condition and existing as man's captives rather than as his companions. This fact throws a strong light into the recesses of brute nature. A baboon to be annoyed at ridicule must understand human gestures, play of features, and tones of voice; and, more than this, he must be himself capable of finding the conduct, appearance, &c., of other beings ridiculous. How else should he comprehend the very nature of derision?

I turn next to ideality—that fondness for beauty which in man comes to light in phases so various; from the craving of the savage for beads and feathers to the love for sublime scenery, for painting, sculpture, and poetry among the leading races. Do brutes appreciate ornament? Beyond all doubt; horses and elephants value their trappings and grow sulky if these are removed.

The phrenologists have, I believe, attempted to refer these facts to "self-esteem" or to "love of approbation." But these sentiments in such a case can only be brought into play through a love of ornament. Between the animals in question and the human being who glories in a compressed skull, in a tattooed skin, in a porcupine's quill thrust through the nostrils, in compressed feet, high-heeled boots, a powdered face or head, or a wasp-waist, the interval is not very wide.

A love of ornament may be constructively shown in wild animals. It is well known that many birds at the pairing season assume, wholly or in part, a more splendid attire, described in ornithological works as the "nuptial plumage." Does not, as many of the most eminent naturalists now hold, this brilliant coat of feathers serve the purpose of attracting the opposite sex? If so the effect could not be answered in the entire absence of a passion for ornament and of a sense of beauty. The Australian bower-bird gives plain proof of this sentiment. In the construction of his gallery he makes use of the most showy objects he can find, and takes great pains in their selection and arrangement. Neither the nature of the materials nor the very existence of the gallery seems to subserve any mere utilitarian object. Some may, perhaps, say that "instinct" prompts the bird to collect and arrange all these baubles. But if this explanation can be accepted it will equally apply to the savage in his fondness for the very same articles. Perhaps the fact—now thoroughly demonstrated—that monkeys can recognise the likeness, coloured or plain, of a member of their own or of some closely-allied species, may here be taken into account.

Next follows in our list the sentiment of "wonder." In virtue of this feeling man, when he recognises anything outside the ordinary sphere of his experience, is more or less profoundly affected. Whether his interest in such phenomenon takes the form of terror or of pleasure—at least attraction—depends on a variety of incidental circumstances. But brutes also recognise an order of nature and are startled by its apparent violation. Of this I once met with a striking instance. A dyer had a favourite poodle upon which he exercised his art so successfully as to change its fleece from white to a full shade of magenta. I one day observed this animal following its master along a street, when a terrier ran hastily up to accost the stranger. On coming closer and perceiving the un-dog-like hue of the poodle he stopped short, gazed for a moment as if bewildered and then fled. Fear—in the sense of physical apprehension—could hardly be the cause of his flight, as the poodle wagged his tail and gave every sign of friendliness.

Mr. Romanes—if I remember rightly, though I am not at the moment able to lay my hands upon the exact passage—describes the conduct of an otherwise pugnacious terrier on seeing a monkey dressed in human costume. He stood at first in astonishment, but, recovering, was about to make an attack on the strange being, when the monkey raised its hat and gracefully saluted him. This was too much for the terrier's nerves; he slunk away and was seen no more till the monkey had been removed.

Mr. Herbert Spencer (" Principles of Sociology") gives some cases of wonder or mysterious alarm displayed by dogs at occurrences transcending the limits of their experience. " One of these cases consisted in a large dog which, while playing with a stick, accidentally thrust one end of it against his palate. Giving a yelp he dropped the stick, rushed to a distance from it, and betrayed a consternation which was particularly laughable in so ferocious looking a creature. Only after cautious approaches and much hesitation was he induced again to take hold of the stick." Mr. G. J. Romanes, commenting upon this case, gives further instances of awe, horror, or sense of the mysterious in dogs, which have come under his own observation. Speaking of a certain terrier he writes:—" Like many other dogs he used to play with dry bones by tossing them into the air, throwing them to a distance and generally giving them the appearance of animation in order to give himself the ideal pleasure of worrying them. On one occasion I tied a long and fine thread to a dry bone and gave him the latter to play with. After he had tossed it about for a short time I took the opportunity when it had fallen a little distance from him and while he was following it up, of gently drawing it away from him by means of the thread. Instantly his whole demeanour changed. The bone which he had previously pretended to be alive now began to look as if it were really alive. He first approached it with nervous caution, but as the slow receding motion continued and he became certain that the movement could not be accounted for by any residuum of the force which he had himself communicated, his astonishment developed into dread as he ran to conceal himself." The dog, Mr, Romanes adds, was under ordinary circumstances by no means timid. He describes another experiment performed with the same animal:—" Taking him into a carpeted room I blew a soap-bubble, and by means of a fitful draught let it intermittently glide along the floor. He became at once intensely interested, but seemed unable to decide whether or no the filmy object was alive. At first he was very cautious and followed it only at a distance, but as I encouraged him to examine the bubble more closely, he approached it evidently with much misgiving. After a time, during which I always kept at least one bubble on the carpet, he began to gain more courage, and became bold enough slowly to approach one of the bubbles and nervously to touch it with his paw. The bubble, of course, immediately vanished, and I never saw astonishment more strongly depicted. On then blowing another bubble I could not persuade him to approach it for a good while. At last he came and nervously extended his paw with the same result as before. But after this second trial nothing would induce him again to approach a bubble, and on pressing him he ran out of the room, which no coaxing would persuade him to re-enter."

Mr. C. G. O'Brien, of Cahirmoyle, County Limerick, writing in the same paper, gives also a striking instance of the sense of the mysterious in a dog. He says:—"Our terrier, a very queer character and a great warrior, is abjectly superstitious. He will not come near a toy cow that lows and turns its head, but watches it at a distance with nose outstretched. A vibrating finger glass terrifies him; indeed he has so many superstitions that we often make him very miserable by working on his fears."

These instances abundantly prove that animals, like man, possess a sense of the marvellous. Though somewhat a departure from my subject I venture to point out that this is at the same time the surest proof of their possession of reason; unless they had some crude conception of an order of nature—some power of distinguishing between the probable and the improbable—nothing could excite their wonder.

Hope, the next emotion in the list, is easily dispatched. Unless dogs or cats hoped to receive scraps why do they continue begging? Unless birds hoped to find to-morrow crumbs where some were thrown to-day, why should we find them assembled on a winter's morning around the breakfast-room window? In so doing they give at the same time inarticulate expression to their recognition of the law of continuity.

I come to conscientiousness. The lower animals have the sentiment of right and wrong, of claims and duties. Rooks, for instance, have some rudiments of criminal law.

Inveterate thieves are sometimes severely beaten, banished from the rookery, or even killed outright. These punishments are inflicted at a general assembly of the rookery. Now law pre-supposes some notion of right and wrong, and could, therefore, never arise among beings incapable of making this distinction.

The following incident, which gives us a most valuable insight into the moral life of brutes, is recorded by Arago in his official *éloge* of Ampère. There is probably no scientific man in the world who would hesitate at recognising the latter as a trustworthy observer, utterly incapable of exaggerating or distorting any phenomena which he had witnessed. Travelling in the South of France—the exact locality is little to the purpose—Ampère had occasion to make a short stay at a road-side inn where a roasting-jack moved by animal power was in use. Two dogs performed the duty of turning the machine, working, as it appears, alternately. The dog whose proper turn it was not happening to be in the way, the other was caught and put in the wheel. He flatly refused, however, to work, and neither coaxing, threats, nor chastisement produced any effect. After some delay the missing dog was found and set to the task. After he had nearly completed the job, Ampère, who bad been greatly struck with the whole affair, proposed that the second dog should be released and the first tried again. This was accordingly done, and the animal so lately recusant now offered no opposition, and made the wheel revolve with a hearty good will till the roast was finished. This experiment showed that the dog's former reluctance was due not to idleness or ill-temper but to principle. He evidently considered that the work was to be fairly shared between himself and his companion, turn and turn about. This incident proves that brutes are able to understand somewhat complicated relations. Had the dog been willing to work whenever ordered, his compliance would have been simply attributable to docility, or fear, or to habit. We find him, on the contrary, obedient up to a certain point, but no further. What is this but the idea of duty and of right? He felt bound to work alternately with his colleague, but when expected to take two shifts in succession he knew that more than his legitimate duty was demanded, and that his rights were consequently invaded. This case alone is quite sufficient to prove that the sentiment of conscientiousness crosses the boundary-line between man and the brutes. It shows that the "actions of animals *are* accompanied by acts of conscious will directed towards the fulfilment of duty.

As to veneration its presence in the animal world has been established by hundreds of observations, summed up in the well-known aphorism "man is the God of the dog."

There remains merely firmness, which carried often to the extent of obstinacy is as plain among animals as is imitation.

We find, therefore, that all the "sentiments peculiar to man" of the Phrenologists are common to him and to some, at least, of the lower animals. How such an erroneous classification of the mental faculties came to be adopted is difficult to understand. Probably Gall, Spurzheim, and Combe were not close observers of animal life and followed the "learned ignorance" of their day in denying to "brutes" all the higher sentiments. Should the science of Phrenology ever be re-constructed in a form capable of harmonising with the results of modern research, this point must not be overlooked.

IV. THE PRINCIPLES OF MAGNETISM.

By Charles Morris.

AMONG the varied phenomena of magnetism, there is one of more significance than has usually been ascribed to it, and which, when considered in all its bearings, would seem to lead us to a fuller knowledge than we now possess of the intimate relations of magnetic particles. This is the fact of the astatic combination into which every two contiguous magnets seek to enter. As a necessary consequence of magnetic polarity, with its mutual repulsion of like and attraction of unlike poles, any two magnets laid side by side will repel each other if their polar axes be in the same direction, and attract if their axes be in opposite directions. This is one of the fundamental principles of magnetic energy, but it is one which has never been worked out to its ultimate significance.

If, instead of two, there be several magnets thus laid side by side, the effort made by each to reverse the polar axes of all the others must cause special relations of axial direction. If free to move in response to this influence, every magnet situated between two others would arrange its poles oppositely, and the combination would be some such as this:

N ———————————— S
S ———————————— N
N ———————————— S

If a number of magnets were arranged so as to form the surface of a hollow cylinder, and, as above, free to shift their axial directions, the relation here given must be assumed around the whole surface, and the poles of the magnets be successively opposite in direction. Of course, if in the above diagram there were five magnets instead of three, the influence of the second would tend to prevent the reversal of the fourth, but the double influence of the third and fifth, and the increased vigour resulting from their proximity, must cause such a polar reversal to take place. But when the magnets become numerous and less regularly conjoined, the above simple arrangement cannot arise. Each magnet would be exposed to several varied influences, and must assume a position in accordance with the preponderant energy of these influences. Thus, instead of yielding to the attractive vigour of the magnet nearest it, the vigour of the mass of more distant magnets must also be felt, and the final position assumed by the magnet arise, not from the isolated influence of any single magnet, but from the resultant of the influences of the whole mass of magnets. It would be a case somewhat resembling that of general attraction in which the sum of the influences between particles constitutes a general central influence. But in the case of a mass of magnets the presence of both attractive and repulsive relations must considerably complicate the result, and the axial direction of each magnet be governed both by attractive and by repulsive influences.

In the case already assumed of a hollow cylinder composed of magnets, each of which is in astatic relation with its two neighbours, if we should now place in the core of the cylinder another magnet equal in vigour to all those forming its surface, new relations would necessarily ensue. The magnets in the surface must enter into astatic relations with the magnet in the centre, their mutual repulsions being overbalanced by the preponderant central attraction. Or if, instead of a single magnet, a mass of small magnets be placed in the core of the cylinder, some similar result would probably arise. The tendency of every two contiguous magnets would still be to enter into astatic union, but this would be overbalanced by the sum of distant forces. Most probably the final relation would be that given above; the central mass of magnets would control the axial positions of the surface magnets, and these exert a like influence upon the centre, while the isolated local influences would be overcome. Thus repulsive relations might exist between contiguous magnets, as a result of their attractive relations with masses of more remote magnets.

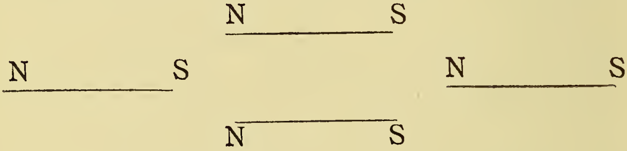
For such relations to be assumed, of course the separate magnets must be free to revolve on their equatorial planes. But even where they have not this freedom of movement the vigour of this influence often shows itself by a reversal of the magnetism of some of the magnets. Such a reversal is stubbornly resisted, and the energy producing it must be considerable. We have instances of this result in the experiments of Coulomb and of Nobili. The former found on examining bundles of magnets that the exterior plates were the strongest, and that some in the interior had their magnetism reversed. Nobili experimented with bundles of fifty small needles which had been powerfully magnetised. On opening the bundles after a short time, all the magnetism continued in the same direction. But on opening again two hours afterwards, several of the needles were found to have reversed their magnetism. In another experiment, part of the needles lost their magnetism. In cases like this a general reversal could not well take place, for every magnet so reversed would exercise a counter force, and diminish the reversing influence upon the remaining magnets. And any vigour of retention of the original magnetism would also oppose the reversing agency.

It may be supposed that the other relation of magnets alluded to—that of freedom to rotate and so change the direction of their axes—could not be produced in practice. Yet the practical existence of this relation may be found in every instance of magnetic energy. For it is well known that magnetism is not an energy belonging to masses as wholes, but that it belongs to their molecules or separate particles, and that what we call a magnet is really a compound mass of minute molecular magnets. In such an aggregate of minute magnets the conditions are different from those applying to masses of larger magnets. In the case of molecules there is no physical resistance to a change of the axial direction. They have no need to reverse their magnetism in response to the surrounding forces, for they are free to readily reverse their positions. Consequently it is very probable that every molecule in such a mass feels the magnetic energy of every other molecule, and freely shifts its axis into the direction required by the superior attraction. The case is like that which would exist between larger magnets if so arranged as to have liberty to revolve, and so placed that the action of their mutual energies could not be counteracted by terrestrial magnetism.

But the side-by-side relation of magnets so far examined needs to be considered in connection with another relation ere we can comprehend the true magnetic condition. This is the end-to-end relation. If two magnets which, laid side by side, would repel—be shifted without a change of axial direction until they become end to end—they will attract. Or if in the first instance they attracted, in the second they would repel. And this relation of magnets must influence and vary the relations we have hitherto considered. Thus the tendency of two magnets to arrange themselves astatically, thus:—

N ———————— S
S ———————— N

would be counteracted in the following arrangement.



The two end magnets would attract the upper one of the astatic pair, and repel or cause a reversal of poles in the lower one. In the new relation assumed the paired magnets would repel each other, but their repulsion would be overcome by the attraction of the end magnets.

Let us again consider a cylindrical mass of magnets, made up of unit magnets arranged thus end to end as well as side by side. The tendency of the magnets in the core of the cylinder to assume an astatic relation with those in the surface, and for this agency to overcome the local influences of magnet on magnet, must be aided by the above arrangement. In any group of surface magnets like that in the last diagram, the influence of the central magnets of the cylinder would be aided by the energies of the two end magnets of the group, and the astatic tendency of any two contiguous magnets would be thus doubly resisted. But at the same time, the astatic tendency between the surface and the central groups of magnets would be assisted. Consequently, in any such magnetic system, the special relations which tend to establish themselves between contiguous magnets must be overcome by general relations between the various sections of the group, most probably resulting in the above condition of astatic relations between the superficial and the central sections of the system. As already said, such a relation could only partially display itself in any group of mass magnets, on account of their resistance to reversal of magnetism. But it could readily appear in groups of molecular magnets, from their ability to shift their axial directions. We are, therefore, not without warrant for the conclusion that in every magnet this relation of its molecules exists, and that the magnetism of the central portions of the magnet is opposite in direction to that of its surface portions.

But still another conclusion must arise from these premises. The conditions here assumed could only exist in the equatorial plane of the magnet. If we take the somewhat parallel case of a globular mass, every particle of which is drawn by attraction towards the centre, we know that this is not because of a force of attraction existing in that centre, but because the attractions of all the remaining particles have their greatest sum in the line passing through the centre. But in the case of a magnetic mass the forces, though in one sense general, are in another sense special. The magnetic particle on the equator of the magnetic mass would be equally influenced by the northern and southern sections, and would thus obey on equally balanced axial influence. But a magnetic particle out of the equator, and nearer one pole than the other, must feel a preponderating influence from the greater mass in the direction of the more distant pole. It would not arrange itself, therefore, in true astatic parallelism with the axial particles; but, if it be nearer the North Pole, it must be affected most strongly by the greater mass towards the South Pole, and thus be thrown out of its reverse parallelism with the axis. As it comes nearer and nearer to the North Pole this reversing influence from the South Polar region must grow more effective, until, when the North Pole is reached, the magnetic particle must become fully reversed, and in direct parallelism with the axis. All this may seem a far reaching deduction from the astatic tendency of any two magnets. But it can be shown that it is in exact agreement with the ordinary phenomena of magnetism.

Although we cannot see the molecules of ordinary magnets, and thus perceive their movements in response to the general magnetic energy, yet we possess one instance of a magnet whose magnetic molecules are plainly visible, and in which we can trace the operation of the principle just laid down. This great magnet is the earth. Its molecules are its crystals, or the other definite units of matter of which it is composed. In the magnetic needle we have a strongly magnetised terrestrial molecule, by whose aid we can test the conditions of the earth's magnetism.

In the ordinary consideration of the earth's magnetic phenomena there is, what seems to the writer, a misconception of the true relations between the earth and the magnetic needle. They are treated as if they were two separate magnets, and their action upon each other viewed in the same light as we view the mutual action of two ordinary magnets. Yet the fact is that the needle forms part of the earth's solid surface, and its magnetism is part of the earth's magnetism. We speak of the north and south poles of the earth with the tacit idea that all the magnetism between these poles lies in the same direction, and that every one of the separate magnetic masses, whose total sum of force composes the earth's magnetic energy, has its poles turned in conformity with the direction of these north and south poles. Yet the behaviour of the magnetic needle should give us a different idea. At the equator it turns its poles opposite to those of the earth. And this is not because it stands above the immediate surface, for if laid upon, or buried beneath and incorporated with this surface, it would not change its axial direction. Only when taken from the equator towards the poles does it gradually change this direction, its axis becoming completely reversed only when the poles are reached.

In all this we have a significant indication of the true conditions of terrestrial magnetism. Although all matter is magnetic, only a small portion of the earth's material is strongly so, though the weak magnetism of the remaining material may slightly add to the total sum of magnetic energy. These strongly magnetic masses are disposed at random throughout the earth's crust, and it is their mutual action which constitutes the main sum of the earth's magnetic energy. In the action upon the needle we cannot assume that some hypothetical concentration of energy at the north and south poles controls its movements, but must rather consider it as principally affected by the vigour of the contiguous magnetic masses, and as assuming a position in accordance therewith. The needle must tend to enter into astatic relations with these masses. But these masses are numerous, and all tend to assume astatic relations with each other. Yet they cannot all assume this relation. The mutual action of any two of them is hindered by the action of the many more distant masses. The result is that local relations of position cannot be assumed, but that general relations must arise, the magnetic masses in one section of the earth becoming astatic with those in another section. The direction assumed by the needle, for instance, is not astatic with that of the superficial magnetic masses of the earth, for they undoubtedly agree with it in direction. It must therefore be in astatic relation with more deep-lying masses. But the needle points in the same direction at every point in the equatorial surface. It follows that the astatic tendency between the superficial magnetic masses is at every point opposed by a constant energy which can only come from the deep-lying figures of the earth. Thus we may view our globe in its equatorial plane, and for some distance to the north and south, as constituting a cylindrical mass, the magnetism of whose superficial regions is opposite in direction to that of its central regions, while the north and south pointing of surface magnets must arise from their astatic relations of attraction with south and north pointing magnetic masses in the earth's interior. The relation, in short, is that to which the consideration of the mutual action of minute magnets led us. Instead of each two separate magnetic masses entering into individual local relations, the whole sum of magnetic masses enters into general relations, and the earth possesses an axial magnetism opposite in direction to its surface magnetism.

The axial magnetism occupies the whole extent of the earth's axis, and displays itself at the poles, the axis being everywhere equally affected by the surrounding exterior surface. (This, of course, requires that the earth should be throughout equally magnetic, and the irregularity of its actual magnetism must produce a certain degree of inharmony in the result.) But on the surface that action obeys another rule. If we take the magnetic needle northward from the equator, it at once feels a preponderant influence from the greater mass of magnetic matter to the south. It no longer continues parallel with the earth's axis, but "dips," its astatic relations with the axis being disturbed. The axial influence upon it may continue the same, but the surface influence is no longer balanced. At the equator the equal "end-to-end" pull of the superficial masses to the north and south aided the reversing influence of the axial magnetism. But at a distance from the equator these surface influences are no longer equal. If it move north the sum of the whole surface influences to the south overbalances those to the north, the axial influence is partly overcome, and the magnet dips its north pole towards the earth's axis. Going still farther north this influence increases, and the reversing movement strengthens. At a certain distance north the reversion is half completed, and the magnet stands perpendicular to the earth's axis. Continuing the northward movement the magnet continues to turn, until, when the extremity of the earth's magnetic axis is reached, a complete reversion is produced, and the axis of the magnet stands opposite to its position at the equator. It has now become a portion of the earth's axis, and all the surface influence is combined to hold it in this position.

The dipping movements of the magnet here considered undoubtedly indicate similar conditions in the earth's magnetism as a whole. At the equator the earth's superficial magnetism is opposite in direction to its axial. Going north from the equator a reversing influence shows itself, the direction of the magnetism slowly revolves, at a certain distance north it becomes vertical to the axis, still farther north the angle becomes greater, and at the magnetic north the reversion is completed, and the axial magnetic direction assumed. Going south the same series of changes occurs, though in the opposite direction. The magnetic needle, therefore, may be looked upon as a testing magnet, through whose movements we may become aware of the true magnetic conditions of the earth. The complete revolution on its equatorial plane, which it makes on passing from the north to the south pole, is significant of a like complete revolution in the earth's superficial magnetism, while its assumption of the same direction at the two poles is indicative of a fixed direction of magnetism throughout the whole extent of the axis.

Were the earth's magnetism very powerful all local action would be lost in the general energy, and we could obtain no knowledge of magnetic phenomena. As it is, however, the mutual influences of two powerful magnets are stronger than that of the earth upon either, and they produce an astatic effect upon each other. But on being separated to a certain distance the terrestrial vigour overpowers the local, and they place themselves—if free to move—in conformity with this general vigour. Doubtless similar astatic influences must arise interiorly when any two magnetic masses are continuous, and the general action of the earth's magnetism must be weakened by such local reversing action.

If now, instead of taking our testing magnet over the earth's surface, we take it inward towards the axis, other phenomena than those above considered must arise. If this be done in the plane of the equator, the necessary reversal of magnetism as the axis is approached cannot take place by means of dip, for the equality of northern and southern influences produces an equal tendency to dip in the two opposite directions. It can only take place, then, through a weakening and gradual disappearance of the magnetic energy, and its reappearance in the opposite direction as the axis is neared, until finally a full opposite energy is gained at the axis. Thus between the astatic regions of axis and surface there must be an intermediate region of weaker, and a zone of no magnetism, produced by these opposing influences.

But north and south from the equator the conditions are necessarily different. If the testing magnet be carried inwards at a point between the equator and the north pole, "dip" phenomena must appear. If it be carried southward from the north pole over the surface a dip reverse to that displayed when it is carried from equator to pole will occur. And if, instead of continuing this movement to the equator, the magnet be carried beneath the surface at any point sufficiently southward, its reverse dip must continue and grow more declared, from the increased vigour of the superficial influence. At a certain depth beneath the surface, then, it would assume the direction which it possesses at the equator, that of reverse parallelism with the axis. Going still deeper the reversing influence must continue, and become complete at the axis. Thus the effect upon the magnet, of thus taking it inward to the axis, would probably be the same as if it had been taken on over the surface to the south pole, a complete rotation of the direction of its axis taking place in either case. Of course it cannot be positively declared what would occur in the case of such a movement beneath the surface, but the action of the astatic influence must certainly tend to produce such a continued rotation.

(To be continued.)

ANALYSES OF BOOKS.

American Nervousness: its Causes and Consequences. A Supplement to "Nervous Exhaustion." By G. M. Beard, A.M., M.D. New York: G. P. Putnam's Sons.

We find here, re-arranged and harmonised, ideas with which the scientific world has been already more or less familiarised, by the author's memoirs in a variety of American journals, and by critiques which have appeared on this side of the Atlantic.*

Dr. Beard considers "nervousness," or, more strictly speaking, nervelessness or lack of nerve force, as a characteristic phenomenon of the present age, and most fully developed in the northern and eastern portion of the United States. There he proposes to study it by that perfectly legitimate scientific artifice which bids us investigate every phenomenon by preference where it occurs in the highest perfection. But here already there is matter of discussion. Dr. Beard uses such language as—"This condition is especially frequent and severe in the northern and eastern portion of the United States;"—"the greater prevalence of nervousness in America;"—A new crop of diseases has sprung up in America of which Great Britain until lately knew nothing or but little;"—"nervousness and the functional diseases derived from it are most frequent in America," &c. In these and in many other passages he states more or less explicitly that the condition of defective nerve-power is more common in certain parts of the American Union than elsewhere. But Mr. E. C. Towne, writing in the "Popular Science Monthly," tells us that "the worn, thin, nervous type is fully as common in England as in America, and often more extreme here than in America;"—"the John Bull type is an exceptional one in England."—"The impression that the English are phlegmatic is a false inference."—"Temper, in fact, and nerves are generally very much worse in England than in America." These utterances seem little in accord with the opinions of Dr. Beard. Yet both writers know the two countries and their inhabitants from personal observation. Still it must be noted that Dr. Beard includes among the signs of the nervous diathesis "susceptibility to stimulants and narcotics and various drugs, and consequent necessity of temperance." Mr. Towne thinks that there would be little difference between the two peoples "if England had had American abstinence for the past fifty years." He states that the characteristics of the John Bull type are " due to English eating and drinking." Again, he speaks of the " puff and colour given to the face by drink." Thus temperance is not in England, as in America, necessitated by climate or other circumstances, and it is possible that Dr. Beard's " nervousness " and Mr. Towne's " nervousness " are not exactly one and the same thing, the latter writer meaning rather exaggerated nervous activity.

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* *See* Journal of Science, 1877, p. 121, and 1875, p. 130.

Our author enumerates, among the reasons for the greater prevalence of nervousness in America, " dryness of the air and extremes of heat and cold." Mr. Towne declares that "the drying irritating corrosive effect of the east wind in the streets of London is very much worse than anything known in America ;" . . . " the irritating effects of the English climate are more than twice as bad as those of the American." . . . " England has ten days of irritating rawness, dryness of cold wind, and poison of dust, to one that America has."

Again, Mr. Towne says, " As for heat, the mistake is no less complete. England suffers more from 78° than America from 98°. There is never a chance to change to summer dress with any security, and heat, when it does come, has to be undergone without preparation. It commonly, moreover, comes with excess of moisture, and has an effect more dangerous than 20 degrees more of American heat." Now we have no personal experience of American weather, and have not the faintest disposition to do battle for the English climate, and especially for our north-east winds. But for all this we must call certain of Mr. Towne's positions in question. In America, during the summer season, sun-stroke is a very tangible evil. In England the heat is never so high as to be dangerous to a man of fair constitution and temperate habits. If in this country we " undergo heat without preparation," the reason is not so much the uncertainty of our climate as our stupid subservience to the dictates of fashion. Half a century ago nankeen, fancy drills, and white jean were common materials for male attire, but these have all been condemned by Mrs. Grundy. Not long ago we read an article by an American writer on the snow-storm of January 18th last. He was particularly struck with the manner in which we were socially paralysed by what in his country would be deemed a mere routine occurrence. Dr. Beard remarks that an English January is merely like an American March " stripped of some of its most objectionable features and on its best behaviour." Our east winds he considered tame and mild as compared with that compound of snow-dust and Cayenne pepper with which New England is scourged. So that on the question of climate experts differ.

The most remarkable point in Dr. Beard's work is that he traces nervousness, with its morbid developments, to the modern type of civilisation, especially as manifested in America, as the five distinguishing features of which he enumerates steam-power, the periodical press, the telegraph, the sciences, and the mental activity of women. Elsewhere he goes more into detail, and adds as causes of nervelessness the political machinery of free countries, the religious excitements which are the sequels of Protestanism, the activity of philanthropy made necessary by the increase of poverty and certain forms of disease, the complexity of modern education, the over-strained division of labour in manufactures, the necessity of punctuality, the effect of noise on the nerves, the increase in the amount of business done in modern times, and the repression of emotion. We notice in particular the following remark:—" A modern philosopher of the most liberal* school states that he hates to hear one laugh aloud, regarding the habit, as he declares, a survival of barbarism ! "

We may now comment briefly upon some of these factors in the production of nervousness. We may first notice how completely the introduction of certain mechanical facilities and appliances has disappointed the hopes with which it was at first greeted. When the steam-engine made its appearance as a substitute for manual labour we were told by the poets and the philanthropists that mankind would have more leisure,—there is a world-wide difference between leisure and idleness,—and consequently more scope for thought, for self-cultivation, and for all those innumerable phases of work which, however important to the community at large, have no immediate market-value. Instead, however, of doing as we might have done, getting through our former quota of work in a fraction of the time previously required, and devoting ourselves to " plain living and high thinking," we have elected still to devote our whole time to business, and to accumulate luxuries which we have neither time nor energies to enjoy.

The distressing effects of noises on the nerves are also noticed, though the author omits the most irritating of all, *i.e.*, the barking of dogs, church bells, and street music.

On political and theological excitement Dr. Beard writes:— " The experiment attempted on this continent of making every man, every child, and every woman an expert in politics and theology, is one of the costliest of experiments with living human beings, and has been drawing on our surplus energies with cruel extravagance for the last hundred years." It is a remarkable fact that insanity is rarer under an absolute government than in a constitutional or a republican country,—rarer, too, in Catholic or Islamite than in Protestant nations. Spain furnishes few cases for the asylum. Madness is far less frequently met with in devout and royalist Bretagne than in the free-thinking departments around Paris and the other great towns of France. It becomes a serious question whether the predominant and growing attention paid to politics is not a grave mistake, and whether it should not be in every possible way discouraged by all who look beyond and above the region of party turmoils.

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* Might not a definition of the term " liberal " be useful in these days?

The following few lines contain a terrible admission :—" Not How shall we live ? but Can we live at all ? is the problem that almost every American is all his life compelled to face." Is this the result of all our boasted " progress " ?

In connection with climate Dr. Beard mentions that Spiritualism in the Southern States is unknown, at least in comparison with the North and the East. He seems here to forget that it finds numerous and very zealous cultivators still farther South,—to wit, in Mexico and in the Spanish republics of South America. We are also puzzled with his statements concerning the use of narcotics. We find it maintained that increasing nervousness renders a people less able to bear the use of tobacco and opium. Yet according to statistical evidence the consumption of tobacco, both for smoking and chewing, is greater than in England. With us, too, smoking is, or has been till within the last few years, decidedly on the increase, *pari passu*, with nervousness. We are somewhat surprised to learn that " through all the Northern States the brain-working classes find coffee more poisonous than whisky or tobacco, and thousands are made wakeful by even a gentle cup of tea."

As a means of combatting the decrease of nerve force he recommends a re-modelling of our educational systems. He enjoins rest, and, like every other man who has escaped infatuation, he condemns cram and its necessary cause—competitive examination. He advises the student in every science to start with the examination of things. He does not consider the acquisition of ancient languages a necessary part of general culture. Under the same head might rank history, which is little better than fossil scandal. Its study was formerly recommended on the plea that it made men patriotic ; but our professors of history have quite outgrown patriotism. The load of lumber which the American student is required to bear upon his shoulders is even greater than in this country. The following passage is truly painful :—" The newspapers and novels that he (the American youth) is and must be prepared to criticise, the sermons and lectures which he is compelled to listen to and analyse ! " Such tasks may be very well for the man of words, but why demand them from those whose future career is to lie among things ?

The author's teachings on the comparative longevity of brain-workers cannot be accepted in their entirety. The boundary line between the two classes cannot be drawn with the sharpness which he attempts. " Nearly all the money of the world," he says, " is in the hands of brain-workers." Yet that class includes multitudes of the poorest of all. Many other of the distinctions which he makes seem to us too arbitrary. But this is a subject into which we have at present no room to enter, though we may return to it on some future occasion.

A German-English Dictionary of Words and Terms used in Medicine and its Cognate Sciences. By FANCOURT BARNES, M.D. London: H. K. Lewis.

IN the present day, when the technical phraseology of almost every Science and of such Arts as are most immediately connected with them is growing with such alarming speed, a Dictionary such as the present is much needed. The scientific language of Germany is in a peculiar position; we find in it words of Greek or Latin origin similar to those so wantonly multiplied by English bilogical writers; we meet with others purely Teutonic, and capable of being "understanded of the people,"—a feature which we should do well to imitate,—and with others which are compounds, or rather mixtures, of these two incongruous elements. Hence even a very fair German scholar may often find himself bewildered, especially if he has the misfortune to fall in with a book printed in the reformed—or rather *de*formed—orthography which has been lately brought into fashion in Germany. A man may be very well acquainted with "Theerfarben," and yet wonder what can possibly be meant by "Terfarben."

Dr. Barnes undertakes to give "most of the technical words used in Botany, Chemistry, and Zoology, as well as those used in Anatomy, Physiology, Medicine, Midwifery, and Surgery." He has not been equally successful in all these departments. The chemical terms introduced are neither very numerous nor strictly scientific, being in many cases those used by pharmacists, miners, &c. They are not in all cases correct; thus we find "Wismuth salmiak blumen, nitrate of bismuth," a compound in which there is certainly no "salmiak," *i.e.*, ammonium chloride. Further, we have "Braunstein essig saures" rendered "acetate of antimony." "Braunstein" is the trivial German name for the native peroxide of manganese. "Kupferkalk" is a very antiquated name for copper oxide, and "Zinnsalz" means not acetate of tin, but hydrated stannous chloride.

Zoology has also fared but scantily. We find "Aas käfer" rendered "dung-beetle" instead of carrion beetle, *e.g.*, *Silpha*, or *Necrophorus*. "Bock-kaefer" is a name given not to the stag-beetle (which is known in German as Hirsch-kaefer), but to the larger Longicornes, such as *Cerambyx heros* and *Prionus coriarius*.

In the botanical department we find "Pappel" (poplar) rendered by the Latin word "Malva." "Fingerhut"—the German name for foxglove, is said to be an adjective, and is rendered "digital."

We perceive that some words are translated into English, and others without any apparent reason into Latin: thus "Gemeiner Hafer"—which means oats—is rendered *Avena sativa;* "Flieder"

—lilac—is given as *Sambucus niger*, whilst "Hollunder" is translated "elder." "Holztheer"—wood-tar—figures as "*pix-liquida*"; "Meer-grün"—sea-green—is interpreted "*glaucus*"; "Petersilie"—parsley—is *Apium petroselinum.* "Thymian" is correctly rendered "thyme," whilst "Thymian kraut," which means exactly the same thing, has become "*herba thymi vulgaris.*" We submit that one of two courses should have been adopted; either all the German colloquial names of plants should have been rendered by their trivial English equivalents or by their strictly botanical names. The author has adopted, however, sometimes one of these courses and sometimes the other.

In human anatomy and physiology, in the names of diseases and their systems of surgical appliances and operations, Dr. Barnes is much more at home, and these departments are accordingly very complete.

In case of a future edition we feel bound to call attention to the numerous typographical errors, such as cyaninde of potassium for cyanide, Eisen-oxhydul for oxydul, Mannerschew for Maennerscheu, Urkem for Urkeim, Anerhahn for Auerhahn, urogallas for urogallus, &c.

We are well aware that a work such as that before us requires an immense amount of labour and care if it is to be accurate, and we are far from being actuated by any desire to find fault. On the contrary, we consider that Dr. Barnes has deserved well of the scientific public, and we trust that he may soon see his way to the reproduction of the work in an amended form. In such an event we beg to suggest that space might be gained by omitting such words as are the same in both languages. The groups of compounds formed from some common word might also be greatly cut down without inconvenience. As an instance we need only refer to such heads as Wunde and Wurm.

The Analysis and Adulteration of Foods. By James Bell, Principal of the Somerset House Laboratory. Part I. Tea, Coffee, Cocoa, Sugar, &c. Published for the Committee of Council on Education, by Chapman and Hall, Limited.

This work, as we learn from the Preface, is to serve as an explanation of the specimens of adulterated foods to be seen at the Bethnal Green Museum, and at the same time as an addition to our knowledge of the composition of various articles of food, and of the methods employed in their analysis. The analyses, we are further told, are almost entirely of recent date,—an obvious truth, since the chemists of the Somerset House Laboratory were, we believe, exclusively engaged with the examination of excisable articles till—on the motion of Sir H. Peek and Mr. Pell—they were constituted by the late administration an ultimate Court of Appeal in cases of adulteration.

The volume before us treats of tea, coffee, cocoa, sugar, and honey. In the section on Tea we notice with pleasure the statement, doubtless official, that India already furnishes considerably more than one-fifth of the gross weight imported. Concerning the composition of tea we find some valuable facts. The total nitrogen present is greater than can be accounted for by the proportion of theine, which has been hitherto isolated, joined to the vegetable albumen. Hence it is fairly inferred either that the existing determinations of theine fall short of the truth, or that some other unknown nitrogenous body must be present. Gum, in the true sense of the term, though stated by some chemists to be present to the extent of 5 to 9 per cent, was found practically absent in the samples examined at Somerset House. A small quantity, *i.e.*, ½ per cent, met with in green tea, is scarcely a natural constituent of the leaf, since, if common report belie them not, the Chinese use gummy matter in making up green teas. Pectin and pectic acid are, however, naturally present. The tannin of tea seems to differ from ordinary gallotannic acid, but Mr. Bell and his associates do not give any decided account of its nature.

The illustrations of the tea-leaf and its fragments, both as seen with the naked eye and magnifying power, are decidedly good. Indeed we must here record our satisfaction with what may be termed the botanico-microscopic portion of the work.

On the score of adulteration the author is certainly no alarmist. He gives it as his opinion that the teas found in commerce, and supplied to the public, have undergone a great change for the better. Quartz and foreign leaves are seldom present to the same extent as formerly, and foreign colouring-matters are neither applied in the same quantity nor of such varied kinds as heretofore. There is nevertheless a reference to the fact that large quantities of spurious tea, such as the notorious "Maloo mixture," have found their way into this country at no very distant date.

As regards Coffee the picture is less satisfactory. We learn that in spite of the increase of population, and till lately of a free expenditure of money, the consumption of coffee has declined during the last thirty years by five million pounds. This is doubtless due to the manner in which chicory has been foisted, or almost forced, upon the consumer. We must own that we have never been able to see any honest reason for the permission—due to Viscount Halifax, formerly known as Sir Charles Wood—to sell coffee mixed with chicory. The consumer cannot be benefitted, since, if he really prefers chicory, he can buy it separately, and mix it with coffee in any proportion he may wish. The chicory-growing farmer, who, if not a tenant of Lord Halifax, may rent land from some friend and neighbour of that nobleman, can have no interest in the matter, unless by means of this permission the nation is induced to swallow more chicory than they would do wittingly. Nor can the grocer be the gainer, unless he can, by dint of the scheme, sell chicory at a very much higher figure than it is fairly worth. We cannot help here calling attention to the now almost universal malpractice of selling ground coffee and "a portion of the finest chicory" in tins, under the mendacious name "Coffee as in France." Surely the most gullible of our countrymen ought to know that in France coffee is sold unground, and to large consumers even unroasted!

From the volume before us we feel justified in expressing a confidence that the entire work, when completed, will be an important addition to the literature of the adulteration question.

A Manual of Practical Assaying. By JOHN MITCHELL, F.C.S. Edited by WILLIAM CROOKES, F.R.S. Fifth Edition. London: Longmans and Co.

THE art of assaying, since it was first practised in our mining and metallurgical centres, and even since the first appearance of the work before us, has undergone very decisive changes in accordance with the increasing demands made upon it. It has been greatly improved in precision and accuracy, and has laid aside in a great measure its rule-of-thumb character. A century ago the assayer's methods might yield results mutually comparable so long as they were applied to ores or furnace products of a known and unvarying composition. But in case of some novel and unsuspected ingredient being present—a very possible contingency—the operator was at fault. Even where no exceptional element occurred, the figures obtained were merely somewhat wide approximations to the truth. Thus in the Cornish copper assay the results obtained fall short of the truth not by a constant quantity, but in a ratio which, though affected by other circumstances, increases generally inversely to the proportion of copper present. The smelter gets more metal out of the ore than the assay shows.

The present, like the last, edition of the work has been most carefully revised and in part re-written by Mr. W. Crookes, F.R.S., who has made a special study of the chemistry of metallurgy, and who has enriched the work with such recently discovered methods as have been found in practice accurate and convenient. Matter that might fairly be considered out of date has been eliminated, and the modern cheminal terminology has been introduced.

As regards the assay of the precious metals great hopes were entertained that it might be simply and rapidly effected by means of the spectroscope. The careful and prolonged researches of Prof. Chandler Roberts, F.R.S., Chemist to Her Majesty's Mint, and of Mr. A. E. Outerbridge, Assistant in the United States Mint, prove that for the present these anticipations were unfounded. Mr. Capel has, indeed, proved that the 1-4000th part of a milligramme of gold will show its characteristic spectrum if the spark is passed through the weak solution of the pure metal. But on operating on an alloy containing 3·8 per cent of gold, the remainder being silver and copper, the spectra of the two latter metals were alone visible. An alloy of copper with from 20 to 25 per cent of gold was tried, and even here the gold spectrum was barely visible. Yet if gold is alloyed with even 1 per cent of copper the spectrum of the baser metal is perfectly distinct. In an alloy of copper with even 20 per cent of nickel the latter cannot be distinguished by the spectroscope. Hence the above-mentioned authorities both conclude that when two or more metals are jointly present the spark can, to some extent, elect as its medium or vehicle the one which is most readily volatilised, Hence extreme sensibility is not a universal characteristic of the spectrum reactions.

There is another practical difficulty not readily to be overcome. The alloys of gold used in the arts are not, and cannot be made, absolutely homogeneous. Two portions, each of 10, or 5, or 2 grains, might give results exactly corresponding; but the minute particles of metal which are volatilised, and which give the result in spectroscopic analysis, cannot be assumed to be safe representatives of the entire ingot.

The work before us has, in the general opinion of practical men, no rival in English literature, and we have every confidence that the present edition will be welcomed as an improvement on the foregoing.

The Herring and the Herring Fishery, with Chapters on Fishes and Fishing, and our Sea Fisheries in the Future. By J. W. De Caux. London: Hamilton, Adams, and Co.

This little book contains such a diversity of matter that the most varied tastes may be gratified by its perusal. As regards the portion which more particularly appeals to our attention, the author almost at the outset exposes an erroneous classification of fishes of which some naturalists are guilty, *i.e.*, a division into such as live at the bottom of the sea, such as invariably live in mid-water, and such as invariably live at or near the surface. He denies the existence of the surface swimmers as a class. The herring and mackerel, types of this group, are oftener fathoms below the surface and are not uncommonly even caught in trawling nets. Mr. De Caux admits, from this point of view, only two great classes—ground fishes and swimming fishes. The former, with rare exceptions, are flat, tenacious of life, and after death less perishable than the free swimmers. Hence is drawn the practical conclusion that free-swimmers like herrings, mackerel, mullets, &c., should be eaten as fresh as possible, whilst soles, turbot, &c., to a certain degree, improve with keeping like game.

The author doubts the alleged power of fishes to support very high and very low temperatures with impunity. Jesse tells us of a gold-fish frozen up in a solid block of ice, and yet recovering its liveliness when the ice was thawed. But Jesse is a very questionable authority, as Waterton declared in quite plain language. In speaking of the specific gravity of the water in different parts of the globe the author makes a remarkable statement. He tells us that "the water of the Baltic is denser than that of the North Sea, and the water of the Dead Sea is denser still." Now all authorities agree that the water of the Baltic is merely brackish, containing less salt than that of the Ocean. Hence it should be not denser but lighter.

On the question whether fishes sleep or not he is undecided. Recent observations at the Berlin Aquarium seem to have decided this question in the affirmative. He denies them the sense of hearing. Nevertheless it must be admitted that the essential portion of the hearing organ is present in most fishes, though in none is there any direct communication between this organ and the water outside the animal. Mr. De Caux asserts that "sound cannot be produced beneath the surface of the sea." So far is this from being the case that the rate of transmission of sound produced under water has been measured, and found to be about four times as rapid as through air.

The author does not think fishes devoid of feeling, and pronounces angling for "sport" to be a cruel and barbarous amusement, the chief seat of the sense of touch being in the mouth and surrounding parts. This, by the way, is a subject for anti-vivisectionist anglers to ponder over! The rubbish often found in the stomachs of cod, &c., he believes is not swallowed by the fish but is thrust down after its death by the fishmonger to weight it.

The periodical migration of the herring he disproves. Herrings do not travel far from the spot where they are spawned as appears from the fact that certain varieties are always found in the same localities. Herrings spawn wherever they happen to be, whether in deep water, over a sand-bank, or near the shore; they spawn at least twice a year, if not all the year round, and the spawn developes not only at the bottom but near the surface. These propositions are fully proved by the facts here narrated.

Into the commercial, statisical, and historical portions of this little work, whilst fully conceding their importance, we are not prepared to enter. We note merely the author's conviction that the sea is not inexhaustible, and that without proper regulations the supply of fish, as far as British waters are concerned, may come to an end.

Transactions and Proceedings of the Royal Society of Victoria. Vol. XVII. Melbourne: Mason, Firth, and McCutcheon. London: Williams and Norgate.

We are very sorry to have to pronounce this volume most unsatisfactory as issued by the principal scientific body in a country like the colony of Victoria, where an almost infinite amount of work remains to be done. From the Presidential address we learn that there are already recorded as natives of Australia 7000 dicotyledonous plants, 1600 monocotyledons, and 1900 acotyledons. Sixty species of *Eucalyptus* have already been described and figured by Baron Mueller in a work which he has in progress. It is satisfactory to learn that a Field Naturalists' Club has been formed which may do some of the work which the Royal Society neglects. The Melbourne Museum of Natural History now numbers upwards of 44,000 specimens completely classed and labelled.

The most interesting paper in the Transactions is an account of the Hodgkinson Gold Field, Northern Queensland, hy the Rev. J. E. Tenison-Woods, F.L.S., &c., which gives a geological, botanical, and physiographical sketch of a little-known region.

Mr. P. H. MacGillivray, M.R.C.S., describes two new genera of polyzoa, *Diplopora* and *Densipora*.

"Additions to the Lichen Flora of Queensland," by Dr. James Stirton, F.L.S., is an account of upwards of thirty new species, several of which belong to new genera. This paper, as well as a subsequent one by the Rev. J. C. Tenison-Woods, on some new marine mollusca, is open to a grave objection. The respective authors have followed the very stale and unmeaning practice of giving the descriptions in Latin.

To us, at least, it seems curious to find in the Transactions of a Royal Society 18 pages occupied with a paper on "Proportional Representation," by a Prof. E. J. Manson. Its proper sphere would have been a political debating club. Two papers on "Recent Improvements in Electric Lighting," and on the "Tay Bridge Catastrophe," are merely accounts of well-known facts and not records of research and observation. In short, to any lover of Science the volume before us cannot be other than a disappointment. The President, indeed, speaks hopefully, and notes the "acquisition of new and energetic working members who have taken up investigation and research." But as to any results the volume before us is silent.

CORRESPONDENCE.

*** The Editor does not hold himself responsible for statements of facts or opinions expressed in Correspondence, or in Articles bearing the signature of their respective authors.

PROFESSOR BALL'S "GLIMPSE THROUGH THE CORRIDORS OF TIME."

To the Editor of the Journal of Science.

SIR,—In a lecture delivered in Birmingham, Prof. Ball, Astronomer Royal for Ireland, recently announced his discovery, by mathematical processes, that the Moon is the child of the Earth. At first, he says, the Moon revolved round its primary very near to it, but in the course of countless millions of ages it has gradually receded from it, and is still receding. This, I need hardly remind your readers, is the conclusion arrived at in my book on "The Constitution of the Earth," * and which has been further expounded in several articles in your pages. (See "Journal of Science" for August, 1880, May, 1881, and June, 1881.) "At the time of its birth," says Prof. Ball, "the Earth was not as we see it now, clothed with vegetation and teeming with animal life. It was a huge inorganic mass, too hot for life, perhaps hot enough to be soft or viscid, if not actually molten. The offspring was what might be expected from such a parent. It was also a rude inorganic mass. Time has wrought wondrous changes in both parent and child. Time has transformed the Earth into an abode of organic life. It has transformed the Earth's offspring into our silvery Moon." The Professor then goes on to describe the way in which these changes have been brought about, in which he declares that he is guided "by a light which cannot deceive. It is the light of mathematical reasoning."

Mr. G. H. Darwin has been making the phenomena of tides a special study, and he has arrived at the conclusion that the solid earth itself is in constant motion, as the result of tidal influence. The Sun produces tides as well as the Moon, but the solar tides are so small compared with the lunar tides that we have hitherto overlooked them. Reasoning mathematically, Prof. Ball concludes that, before the Moon existed, the Earth was disturbed by the solar tides alone. These primitive tides were manifested as throbs in the actual body of the Earth itself, which was then in a more or less fluid condition. Though at this remote epoch the solar tides were small, as they are at present, a succession of impulses can produce a great effect. At first the vibrations were small "but at each succeeding impulse the amplitude was augmented, until at length the cohesion of the molten matter could no longer resist: a separation took place; one portion consolidated to form our present Earth; the other portion consolidated to form the Moon."

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* The Constitution of the Earth; being an Interpretation of the Laws of God in Nature by which the Earth and its Organic Life have been derived from the Sun by a Progressive Development. London: George Bell and Sons.

Thus, according to Prof. Ball, the Earth and the Moon were created. I have not in my book ventured to enter into such minute detail, but I am exceedingly glad to find that the Astronomer Royal for Ireland does not see any mathematical objection to my theory of the Moon's receding motion.

The Moon, having thus assumed an independent existence, began to recede very slowly from the Earth, and Prof. Ball thinks that, at the time when the earliest stratified rocks were being laid down, it may have been 40,000 miles away from it. "On the primitive oceans the Moon raised tides as it does at present; but the 40,000-mile Moon was a far more efficient tide-producer than our 240,000-mile Moon. The nearer the Moon the greater the tide. To express the relation accurately we say that the efficiency of the Moon in producing tides varies inversely as the cube of the distance. . . . If the present tides be 3 feet, and if the early tides be 216 times their present amount, then it is plain that the ancient tides must have been 648 feet. . . . These mighty tides are the gifts which Astronomers have now made to the working machinery of the Geologist. They constitute an engine of terrific power to aid in the great work of Geology. . . . As the Moon recedes, the period which it requires for a journey round the Earth increases also. . . . Do not infer that the rate of the Earth's rotation is increasing; the contrary is the fact. The Earth's rotation is getting slower, and so is that of the Moon; but the retardation of the Moon is much greater than that of the Earth. Even though the rotation of the Earth is much more than the primitive three hours, yet that of the Moon has increased to several times that of the Earth."

Such are the discoveries which Prof. Ball has made by the light of mathematical reasoning, whilst sitting, as he says, at his desk, and as the result of diligent labours of the most abstruse kind.

The Professor does not, however, inform us by what means the Moon has reached its present distance from the Earth. He obviously believes that gravitation is an absolute force in Nature, and not, as Newton taught, a purely abstract conception of the laws or principles of motion. Why did not that same attractive force which caused the big tides when the Moon was so much nearer the earth prevent the moon from receding? What has been the force which has raised the Moon 240,000 miles from the Earth? We have been told that the attractive force of the Sun originally lifted the Moon out of the Earth; but as, according to Prof. Ball, the Earth is eighty times as heavy as the Moon, the Sun should certainly have exercised as great an attractive force upon the one as upon the other, and therefore no further separation should have taken place. They might both have dropped into the Sun before now, but, if the attraction of two bodies varies inversely as the cube of their distance, it was impossible for them to move asunder. The theory that the Sun's attraction may have been the cause of the Moon's receding motion is, moreover, utterly inconsistent with the fact that, in one portion of her orbit, she is 240,000 miles more distant from the Sun than is the Earth. Instead of the Moon being attracted towards the Sun, in one-half of her orbit she is going in the reverse direction, and does so to the extent of 480,000 miles. The same attractive force cannot be supposed to produce opposite mechanical effects.

Prof. Ball believes that "every body in the universe is capable of producing, and actually does produce, tides in every other body." The Earth may therefore have arisen from the Sun, as the Moon has arisen from the Earth. If the Moon is the child of the Earth, reasoning from analogy, the Earth may be supposed to be the child of the Sun. Such is my conclusion. Children are in the habit of growing. I believe that the whole of the planetary bodies have been derived from the Sun by a progressive development. The evolution of species is part of a great scheme of creation in which the whole solar system is concerned, and "natural selection" is one of many methods by which organic life is brought into harmony with the Earth's perpetual constitutional change. My conclusions are founded, not upon mathematical reasoning based upon a fiction as to the power of gravitation, but upon an immense range of circumstantial evidence, supported by direct observation. Biologists and geologists both inform us that the history of the Earth has been one of progressive development. The facts of Astronomy teach the same lesson. Thus there is a relation between the sizes of the planets and their distances from the Sun; suggesting that, if they have risen from the Sun, as Prof. Ball says the Moon has risen from the Earth, they have grown as they have receded. There is a relation between the number of satellites of a planet and its distance from the Sun; again suggesting a progressive development. There is a relation between the rotary motion of a planet and its distance from the Sun, the rotary velocity increasing with the distance. Instead, therefore, of the Earth's motion of rotation having diminished, as alleged by Prof. Ball, the facts point in the opposite direction. This conclusion is, moreover, supported by the measurements of the Earth's distance from the Sun in connection with the transit of Venus, which distance has been found greater at each succeeding measurement; and the Earth's growth is demonstrated by the cracks which are everywhere found on its surface,—such cracks as, I venture to say, can neither be satisfactorily accounted for by tides nor denudation,—and by the fact that, whenever a base line has been measured a second time at the expiration of any considerable number of years, the latest measurement has always been found the longest.—I am, &c.,

ROBERT WARD.

Newcastle-upon-Tyne, December 12, 1881.

GEOLOGICAL FAULTS: SUGGESTIONS.

To the Editor of The Journal of Science.

SIR,—Faults are one of the mysteries of Geology, and it is to make a suggestion or two that I venture to communicate with you, which perhaps might be utilised and taken advantage of by gentlemen who have ample opportunities for demonstrating, &c.

Why are faults, as often found, V-shaped? How has such a phenomenon occurred?

If these faults be examined, are they not found with one leg continued—a rough Y? This at once suggests itself as an explanation if one side totally outside the V was to slip or rise. Would it not very probably dislodge this wedge-shaped piece from off the other ridge side of the fault? Or if both moved, as is possibly unlikely, ditto? I should think it would be found, on extensive observation, that the lines of strata in such faults would be nearer on a level on one side of the V than on the other; *e.g.*, if a down throw to the left, the strata in the wedge would be nearer to the corresponding strata on the *right* side than on the left, because the second side of the wedge would not begin until the other had made some progress in order to tear it off, &c. Faults are not wholly owing to district subsidence, or more remotely to shrinkage. May not the unequal compression of underlying strata, originated by pressure, escape of gases, heat, water, &c., in those strata be the cause thereof? Because faults are decided, and long, in many cases. As to compression witness stone-packed walls, &c., in mines, &c.

It is demonstrable that faults of the same district are not all of the same period. The new formations are found lying unconformably on older formations, *each* with their separate set of faults. And probably under these again would be other sets. I am strongly inclined, therefore, to believe it to be owing to causes ending finally in local compression, or *yielding* fluctuation of strata, waves, in a rough sense, of semi-fluidified strata.—I am, &c.,

D. Y. C.

Leeds, December 2, 1881.

PROFESSOR HUXLEY ON ANIMISTIC HYPOTHESES.

To the Editor of the Journal of Science.

Sir,—Perhaps, in the interest of Modern Medicine, you could kindly spare so much space in an early issue of the "Journal of Science" as will enable me to direct attention to a fallacy involved in an assertion of Mr. Higgins, in the "Correspondence" columns of your last number, while traversing Professor Huxley's contention in a Lecture before the late Medical Congress, "that contemporary physiological science is antagonistic to Animism." Your learned correspondent holds "that in our modes of thought and expression we cannot help being animistic, and that in Biology 'mimicry' cannot be expressed except in terms of Animism." But surely a little reflection will satisfy even Mr. Higgins himself that the very reverse is the case, and that we cannot express animistic ideas except in terms which belong to Hylozoism, the nomenclature of Immaterialism being strictly materialistic. The very term *Anima* itself, *Spirit*, *Soul*, *God*, *Ghost*, *Psyche*, *Pneuma*, *Angel*, *Heaven*, and even *Idea* (vision), have all primarily a materialistic and temporal, or physical and somatic, derivation and signification. Vain are all our attempts to escape from the *mechanism* of our anatomy; a vanity which seems, conclusively, to answer Mr. Higgins's challenge to Prof. Huxley, by giving mechanical (histological) rationalia for all so-called animistic phenomena.—I am, &c.,

Robert Lewins, M.D.

Army and Navy Club, December 5, 1881.

BUTTERFLY MIGRATIONS.

To the Editor of the Journal of Science.

Sir,—In looking over the notices of butterfly migrations I find that, in many instances, a flight of these insects seems to have been the presage of a storm coming from the same quarter. Is this a mere coincidence, or is there a causal connection? Perhaps your able contributor Mr. A. H. Swinton may be able to throw light upon this question.—I am, &c.,

Constant Reader.

ANIMISM *versus* HYLOZOISM.

To the Editor of the Journal of Science.

Sir,—Courtesy, no less than what I regard as the cause of truth and sound philosophy, alike demand a few concluding words from me in reply to those who thought it right to criticise the Animistic view I put forth in your pages twelve months ago; and who reaffirm their opposition (though I grant in a most fair and temperate manner) in the letter printed in your December number. Of the seventeen sentences of which that letter consists I select some five or six as containing the gist of the controversy between us:—

(1.) My motto, "God is light," is pronounced *suicidal*, being apparently taken as equivalent to saying that Light is God—a converse which is the reverse of the truth. But does C. N. really think that either St. John or myself intended to affirm that 'God is light' in a literal sense? It means one of two things, probably both: that God is the Source, Origin, and Cause of natural light; or that this element—the purest, most wonderful, and most universal of all created things—is the most suitable emblem of Him who made it. Objectively, light is the æther in vibration. This motion is due to a force or power ever acting in various modes and degrees: and I maintain that that power is the power of the Almighty—the Anima Mundi, as He has been called.

(2.) *Function*, no doubt, means *office*, *duty*, or *operation*. Then, according to C. N., *mind* is an office, duty, or operation of *matter*. But each of these terms implies a conscious agent who fulfils the duty, or performs the operation; it implies, in fact, *mind*. It is obvious, however, from the fourth and some other sentences in this letter, that C. N. is using the word 'mind' in a different sense from that in which I employ it, viz., as signifying thought, desire, intention, &c., while I use it to indicate the *person* or *being* which thinks—the *ego*, the man himself. The distinction here referred to is as important as it is real, and the neglect of it produces endless confusion. It is fully recognised in the Latin by the difference between 'animus' and 'anima,' the former being C. N.'s sense, the latter mine. Mind in the former sense is the outcome or manifestation, or perhaps condition, of mind in the latter. But further, C. N. asserts that the brain (or its grey matter) "thinks—*ergo*, it exists." I neither dispute the existence of the brain, nor that it *thinks*, *i.e.*, that it is the organ of thought. It does not think, *as* matter, but because it is associated, for a time, with a living conscious entity. If it could think, *per se*, it should do so when separated from the rest of the body, which no sane person will affirm. God has made the brain, or its gray matter, if you please, essential to thought, and it is only in that secondary sense that it can properly be said to think. The celebrated phrase 'Cogito, ergo sum' must not be thus travestied, for the 'ego' is the living soul, and not one of the bodily organs. It has been well said on this subject, by Dr. Moore, "Thought has no analogy to any known property of matter. Could any one dare to talk, even in metaphor, of definite atoms of mind? or of a soul being divisible by weight or measure?" But there is nothing inconceivable in the idea of an union or blending of a material with an immaterial entity.

(3.) C. N. makes the marvellous assertion that "The volitions of man are . . . as purely due to physical causes as the fall of a stone." If 'due to' means 'influenced by,' no one will dispute the truth of the assertion. But more than this is intended. This idea is made by its advocates to be a ground for the denial of the freedom of man's will and of his responsibility to a higher power, and is closely allied to Fatalism. Nor will the clause "in the last analysis" save it from the charge. But the illustration upsets the thesis. For gravitation, which brings a projected stone to the solid earth, is allowed by the best philosophers to be not only an universal (as far as we know), but an *ultimate*, fact: *i.e.*, one explicable *only* by referring it to the Supreme Will, and this implies a Mind. So does human volition imply a human mind.

(4.) The 'phlogistic theory' is again produced, and declared to be parallel with the 'animistic theory,' and to 'have no *analogic* ground for supposing a levitating factor.' Without admitting the parallelism, I venture to remark that such an analogy, though no doubt an inadequate one, *does* exist. For a mass of cork or a bladder of air, attached to a stone in water, would be a 'levitating factor' to raise it to the surface.

(5.) But I gladly turn from criticising to commending. In sentence 12 C. N. alludes to "a power 'behind' organic function which presides over the animal economy"—(I would add, 'and much more'); and says that Hylozoism is not concerned to dispute the existence of an *ubiquitous* Deity. Well, Haeckel himself admits as much as this; and Goethe much more, when (after St. Paul) he calls the Deity 'the *All-Upholder*.' But C. N. adds, *If* we assume this "we must believe that He acts in all cases directly, and not by living or lifeless mediation." This is a 'non sequitur.' If such a Being exists, He must have a *Will;* and whether He acts one way or another must depend absolutely upon that Will. It is perfectly true that He—

> "Warms in the Sun, refreshes in the breeze,
> Glows in the stars, and blossoms in the trees."

Yet none of these natural objects is *God:* they are but his beauteous works, and gifts to his sentient and rational creatures. Nor do I object to their being called 'the Epiphany,' that is 'Manifestation of God's Power.' Then let us all adore Him, love Him, and obey Him, for He is the "Father of all mercies." Such Science as this, so far from being *degrading*, is the most noble and elevating of all Sciences, and I cannot imagine that you, Sir, would deem it unsuitable to your Journal.—I am, &c.,

J. H. Barker.

NOTES.

The "Gentleman's Magazine" gives the following "strange story":—"While the subject of ghosts is attracting attention, I will offer a nut for our scientists to crack. For obvious reasons I am compelled to omit names. The wife of one of our most distinguished scientific men—I use the term 'most distinguished' advisedly, since the reputation of the man in question is cosmopolitan—saw nightly an old man seated in an arm-chair, near the fireplace in her bed-room. Being thoroughly imbued with her husband's views upon scientific subjects, she held her peace, and tried with partial success to convince herself that it was a delusion. Somewhat later this room was converted into a night nursery, and ultimately into a spare bed-room, with the result that each successive occupant, juvenile or of mature years, described the curious old gentleman who came and sat by the fire. My scientific friend has 'pished' and 'pshawed' at these statements, and has treated the whole matter as ridiculous. He has, however, been compelled to concede something to the vision or the delusion, and to quit the house."

Our attention has been drawn to an able letter on the inconsistency of Anti-Vivisectionists, which appears in the "National Reformer." We make a significant extract:—"A year or two ago some men were charged with skinning frogs alive, and then putting salt on them to see which frog could be made to jump the farthest. As this was done for sport, and for a wager, the magistrate had to dismiss the case, remarking that had such actions been done for any scientific purpose a severe penalty could have been inflicted."

Not wishing to be unjust to any body of men, we must modify the opinion we have expressed that the Free-thinkers of England were, as a whole, pledged to the Anti-Vivisectionist movement, and consequently to be ranked as enemies of Science.

The disease among peach-trees known as the "Yellows" is gradually spreading in the United States, and without due care it will be imported into Europe.

Mr. W. H. Edwards ("American Naturalist") questions the assertion of Mr. Scudder that *Danais Archippus* is single-brooded over all North America, and continues on the wing through the season, laying eggs all the time. He, on the contrary, finds that there are three or four broods yearly in West Virginia, and that the females which have hybernated die in May, after having deposited their eggs.

It appears that no beautiful or useful organic species, animal or vegetable, becomes naturalised in any country without human intervention, whilst the noisome and the ugly contrive to extend their range in spite of man's efforts to the contrary.

The "American Naturalist" records a peculiar bellows-like structure of the anthers of *Rhexia Virginica*, by means of which the pollen is actually blown out upon the body of a visiting insect.

M. H. Viallanes ("Comptes Rendus") communicates very interesting results on the post-embryonic development of the Muscidæ. The tissues of the larva are destroyed before the adult animal is formed, and at a certain point of time the pupa has a true embryonic character. The entire skin of the body is destroyed by the degeneration of the hypodermic cellules, so that the animal is merely bounded by a thin cuticle. On cutting open the abdomen of a pupa of from two to four days, we find the body composed merely of two layers of cellules; the one forming a solid chain composed of the epithelial cellules of the digestive canal reverted to the embryonic state, and the other at the circumference formed by embryonic cellules derived from the muscular nuclei and the cellules of the adipose tissue.

According to Mr. Francis Darwin the phenomenon of circumnutation can be distinctly traced in the *Phycomyces*.

Mr. A. Tylor ("Geological Magazine") calculates that the denudation of the land by rivers and the sea, with the present rainfall, is equal to one foot in a thousand years, and in the Pluvial period ten times as great. Hence the deltas of all our great rivers are later than Post-pliocene, and of the age of the Pluvial period.

Mr. Clement Reid, F.G.S. ("Geological Magazine") combats the views of Mr. Howorth as to the sudden extinction of the mammoth in Siberia. He considers it evident that the mammaliferous deposits in that country cannot have been frozen all at once, or through radiation from the present surface, as there are numerous sheets of clear ice, which must have been successively formed, interstratified with the ice.

Dr. Merrill ("Forest and Stream") states that, according to the belief of certain Indian tribes, certain small birds effect their migrations upon the backs of larger ones, such as the sandhill crane, the white crane, and the Canada goose.

Mr. J. A. Allen ("Scribner's Magazine") gives the following conclusions on the migrations of birds:—That the habit of migration resulted from changes of climate, occurring at a not very remote geological period; that every gradation occurs between species the most widely roving and such as are stationary, and that even members of the same species may be either migratory or stationary, according as they occupy for breeding stations the northern or southern portion of the common habitat; failure of food induces a return towards warmer regions (this is not the case with the swift, which leaves England in August, when its food is plentiful); that the return to the breeding station is prompted by the recurrence of the breeding season; that they pursue certain routes guided by inherited experience, and that they discern approaching meteorological changes.

H. D. Minot (" American Naturalist ") makes some very interesting notes on the migration of birds. Thus in case of some species a single pioneer bird has been known to arrive about a week sooner than his fellows, and to depart southwards again. The most favourable haunts are the first revisited. The general character of a season has a great influence on the time of arrival, whilst temporary heat or cold has little save upon water-fowl. The order of species is uncertain, even amongst near allies.

According to Mr. W. E. D. Scott, of the Nuttall Ornithological Club (" American Naturalist ") migratory birds, when travelling by night, fly at elevations of from 1 mile to 4 miles above the earth's surface, and in clear nights can thus recognise the leading features of a very wide sweep of country.

The Anti-Vivisection craze will find no countenance in France. The new Minister of Education, M. Paul Bert, is himself a man of Science.

The " Revue Spirite " and " Light " give the following incident under the heading " A Pathological Phenomenon " :—" A girl of sixteen has been ill here for eight months. For the last twenty days she has been without food or substantial liquid. During the latter time she predicted that at a certain hour or a day she would have a fit, and would be thought dying; but that at a certain hour she would wake up and ask for food. The prediction proved true. When she woke she was ravenously hungry, and ate without inconvenience. Her abdomen had been in her illness tympanitically distended. Part of her prediction was that the distention would disappear, and it did very rapidly. From the time of her leaving off food she spoke several languages of which she knows nothing in her ordinary state; knew persons whom she had not seen before, and what they had about them; knew their thoughts; knew those who talked of her, and what they said; and putting her hand upon an open book she knew the page and contents of it; the time of day without the clock, &c. She had not been magnetised." This narrative is dated Campan, Upper Pyrenees, August 28th, 1881, and is signed by D. Adorret.

According to the " Boston Journal of Chemistry " a " malarial wave " is extending over New England.

The same journal revives the tradition of spider's web, or preferably an entire live spider, being a permanent cure for ague.

Prof. A. B. Prescott, in a paper read before the American Association for the Advancement of Science, shows the limited biological importance of the organic syntheses effected by chemists. He admits that all the matter of protoplasm is in a state of chemical combination, but that it cannot therefore be accepted that chemical composition supplies the essential conditions or impulses for organisation or other vital functions. The synthesis of all the chemical compounds of the living body may or may not be attainable in the laboratory, but its success would give no whit of promise for the development of organisation. Chemical action is distinct from cell organisation as it is from heat, cohesion, &c., and its correlations with all these forces have to await demonstration by experiment. Cell growth appears to be a necessary factor in the simple splitting of sugar into alcohol and carbon dioxide, and it may or may not be an essential factor in the chemical synthesis of proteids or of cellulose.

M. L. Crié, in a communication to the Academy of Sciences, gives an account of phosphorescence in a number of cryptogamous plants, such as *Agaricus olearius*, *igneus*, *noctilucens*, *Gardneri*, *lampas*, &c.; *Auricularia phosphorea* and *Polyporus citrinus; Rhizomorpha subterranea* and *setiformis*, &c.

M. E. Yung ("Comptes Rendus") has observed that the diet of tadpoles has a remarkable influence upon the relative numbers of the two sexes.

M. A. Gaudry has laid before the Academy of Sciences an account of a deposit of the bones of the reindeer discovered near Paris. He gives the following sketch of the history of the quaternary epoch in the Paris basin :—1. Hot phase : deposits of St. Prest ; *Elephas meridionalis*, transition from the tertiary to the quaternary period. 2. Great glacial phase : deposit on Montreuil ; herds of reindeer ; *Rhinocerus tichorhinus*. 3. Hot phase : diluvium at the foot of Montreuil ; *Hippopotami*, *Rhinocerus Merkii*, *Elephas antiquus;* fig-trees and laurels of La Celle ? 4. Temperate phase : diluvium of low levels of Grenelle ; mixture of tropical and arctic forms. 5. Brief return of cold : reindeer ; the rhinoceros disappears. 6. Present climate : epoch of polished stone.

M. P. Bert, the new French Minister of Education, has communicated to the Academy of Sciences an important paper on the limits of safety in the surgical use of anæsthetics. His researches necessarily involved experiments which in England would be branded as vivisection.

M. E. Grimaux ("Comptes Rendus") has succeeded in the synthesis of a body resembling in many of its reactions the proteine compounds. His point of departure, however, was of an organic nature.

A singular meteorite fell at 3.35 p.m., March 14th, 1881, about 1¾ miles from Middlesborough, and is described by Prof. Herschel in the "Monthly Notices" of the Royal Astronomical Society,

According to M. F. Hément ("Comptes Rendus") children deaf from birth, and who have been taught to speak at the Pereira Institution, acquire the peculiar accent of their native district. M. Blanchard calls this observation strongly in question.

M. A. Certes ("Comptes Rendus") shows that the ova of certain low crustaceans, especially *Artemia salina*, can bear with impunity desiccation for months, and even for years.

M. H. Toussaint, in a paper read before the Academy of Sciences, supports the contagious character of tubercular disease.

We note with regret that a medical contemporary actually proposes that University professorships should be won, not *rebus gestis*, but by competitive examination!

Dr. Noerdlinger ("Central Blatt für Forst-Wesen"), as the result of prolonged observation, denies that the quality of timber is in the least influenced by the age of the moon at the time of felling.

According to the experiments of E. and H. Becquerel, conducted in the Jardin des Plantes in the winter of 1879-80 ("Œsterr. Landwirth. Wochenblatt"), a thick layer of snow does not protect the subjacent soil from falling below freezing-point. Grass-turf is a more efficient protection.

M. Duponchel ("Comptes Rendus") traces an agreement between the curve of the solar spots and the actions resulting from the eccentric movement of the large planets.

M. P. Laur ("Comptes Rendus") finds that under certain circumstances electric currents may be produced by solar light.

Dr. Manuel da Gama Lobo, of Rio Janeiro, is said to have discovered the toxic agent in yellow fever to be derived from a "species of Infusoria, the *Opunsia Mexicana*, which belongs to the family of *bacillæ*." (We fear there is here some error; bacillæ are certainly not Infusoria.)

"Science" gives an account of a meeting of the New York Medico-Legal Society when a paper on Alcoholic Trance was read by Dr. Crothers. The discussion which followed took a very personal form.

Prof. Winchell, of the University of Michigan, in a Lecture delivered before the Summer School of Philosophy, at Greenwood

Lake, declared that "Evolution is the name of a mode of continuance, not of a mode of beginning. It can neither affirm nor deny any mode of origin."

An extensive collection of British birds, contained in two hundred cases, has been recently presented to the Preston Museum by Mr. J. B. Hodgkinson.

In the "Transactions of the Edinburgh Geological Society" Mr. T. Stock gives an interesting account of certain Natural History collections which he inspected during a tour on the Continent in 1880. We note the following very just reflection :—"A public museum rarely has money enough to purchase the larger collections as they appear from time to time in the market, and the fact of its being known to possess a revenue at all (the amount of it is exaggerated in popular estimation) has the effect of stinting private beneficence." He considers that "the best museums of Natural History in Britain are rather in advance of than behind the majority of Continental institutions of the same rank."

The volume of the "Journal of the Royal Microscopical Society" for 1881 has just been issued. There is no reason in any way to alter the opinion already given respecting the merits of the work. It is certainly unique among societies' journals, as it not only publishes the papers read before it, and reports of the meetings, but it gives an account, often at considerable length, of the progress of every branch of science in any way relating to the microscope. The papers read before the Society have during the past year been only thirteen in number. At first sight it would seem remarkable that an influential society should have the original contributions to its Transactions fewer in number than they were ten or twenty years ago; but it must be borne in mind that papers which formerly came before the Microscopical Society exclusively are now received by many other societies, although from the manner in which the observations have been carried out they would quite as justly come within the province of the Royal Microscopical Society. There has, however, been no dearth of matter, for owing to the energy of the Editors the volume contains more than a thousand pages, and gives a very full account of nearly everything that has transpired in microscopical matters all over the world.

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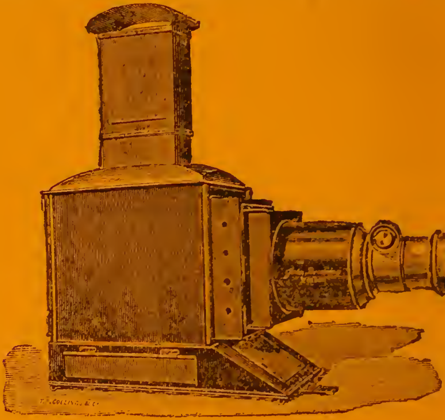

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THE

JOURNAL OF SCIENCE.

FEBRUARY, 1882.

I. MIND-READING OR MUSCLE-READING.

OUR readers are of course acquainted with the theory of so-called mind-reading put forward by Dr. G. M. Beard, in our number for July last.* It will be remembered that this investigator refers the phenomena produced to a power of detecting and interpreting involuntary and unconscious muscular movements, and declares that "mind-readers are only able to find *direction* and *locality*, and in order to find even these they must be in physical connection with the subject, who must *move* his body or some portion of it. . . . Mind-readers never tell what an object is, nor can they describe its colour or appearance." We may add that in most cases Mr. Irving Bishop is not content to lead the subject about, but drags him or her in a somewhat tumultuous manner. This seems to speak in favour of Dr. Beard's theory, as if during violent motion unconscious muscular action on the part of the subject were more likely to be produced and recognised.

By way of throwing further light upon this theory we reproduce the following letter, which has been forwarded to us by the writer. We may remark that Mr. Edmonds, as a graduate of London University and as the head-master of the Brighton School of Science and Art, may be accepted as a qualified and trustworthy observer, not likely to be himself deceived or to attempt any imposition upon the public. He writes :—

---

* Journal of Science, Third Series, iii., p. 407.

"To the Editor of the 'Sussex Daily News.'

"SIR,

"With reference to the correspondence which has been going on in your columns relative to 'thought-reading,' may I be allowed in a few words to state my experience? Having seen and heard Mr. Bishop during his first visit to Brighton I determined to try the question for myself. Being in London soon after, and mentioning to the friends with whom I was staying what I had witnessed, it was proposed that we should attempt the experiment. Accordingly I was blindfolded and left the room. Whilst I was absent a reel of black cotton was secreted in a flower-pot near the window. On pressing the hand of the gentleman who had secreted it against my forehead, and requesting him to think of the object he had hidden, I saw plainly with my blindfolded eyes, as though in a dream, the figure of a reel of black cotton floating before me. I then told him to think of where he had hidden it, and I saw and led him to a bureau at the opposite end of the room to the window. This he said was wrong, but on enquiry I found that he had originally intended to have placed it there, but had altered his mind. Does not this, then, seem to point to the same thing that Mr. Bishop spoke of last Wednesday—of unconscious thoughts passing through the mind? In the next experiment a china plate was placed on the table. When I was brought in I saw it vividly, and led up to it, laying my hands over it, and I described it as a round mat, thicker at the edges than within, and with a dark rim, which was just the description of the plate, which plate, by-the-bye, I had never seen before. We then tried the question of localising a pain. Being blindfolded, and holding my friend's left hand against my forehead, I told him to imagine a pain. Almost immediately I felt a peculiar, indescribable sensation on the right side of my face, and told him that he was thinking of a pain there. He was, in fact, imagining a violent attack of neuralgia in the right upper jaw. Other experiments were tried, and have been tried since, some successful, some unsuccessful; but I have seen quite enough to convince me that there is truth in it. I don't pretend to offer a reason, but I would say to those who disbelieve it—'try for yourselves.' All do not possess the power. I was the only one of a party of six or seven who was thus affected, but, doubtless, there are very many who could perform precisely the same experiments that Mr. Bishop showed, and by continued enquiry it may be that the mystery will be solved.

"I am, yours, &c.,
"Henry Edmonds, B.Sc. (London)."

We see that in these experiments physical connection was found needful. No one has, it would appear, in experiments of this class, ever professed to read the thoughts of another without direct or indirect bodily contact. Where there is no connection at all, or where operator and subject are linked together by an inroganic medium, as, *e.g.*, by a wire, the conditions of success are wanting.

Mr. Edmonds, however, seems to have gone a stage beyond what Dr. Beard pronounces possible : he distinguishes colour. This one fact seems to us fatal to the theory of unconscious muscular action. We may very easily comprehend that the arm of the subject,especially if he is in a state of nervous excitement,—as will often be the case in such performances,—may give certain indications capable of serving as a clue to the direction and the locality of the hidden object, and even to pick it out from a number of other articles ; but we think it impossible that any muscular action of the subject's arm could suggest to Mr. Edmonds the notion of a cotton-reel at all, and still more of a black rather than of a grey, a white, or a blue reel. It is important to know whether Mr. Edmonds at once, at this stage of the proceedings, announced the nature and colour of the article which had been hidden. The experiment with the plate, where the dark colour of the rim was recognised, tells equally against the "muscle" theory. It would seem, therefore, that there are persons who, when placed in actual bodily contact with others, can, to a certain limited extent, perceive what is passing in the mind of the latter. Nor is this power confined to the case of tangible, material objects, as appears from the experiment of localising a pain.

We quite agree with Mr. Edmonds that further experiment is here urgently needed. Those who possess the power should try if it be possible to recognise in this manner a past experience or a future expectation upon which the subject is concentrating his mind. The question further suggests itself whether any connection between the operator and the subject, save that effected by the living body, will answer the purpose. Dr. Beard's experiments certainly show that a metallic medium like wire is useless, but we do not learn whether he has tried leather, wool, silk, or other lifeless organic matter.

As to the results of such experiments it is utterly idle to speculate prior to the actual trial. But there is one consideration which here suggests itself that is not undeserving of examination. So-called "mind-reading," though publicly exhibited in America by Brown as early as 1875, and though formally described and discussed by Dr. Beard in the "Popular Science Monthly," in February, 1877, has only been recently made known in this country by one who, we understand, assumes the part of an exposer of Spiritualism. We may therefore justly ask in how far will mind-reading, as already known, throw any light upon the so-called "Spiritualistic" manifestations? The preliminary difficulty occurs that mind-reading is itself unexplained in its nature, and that consequently if we use it to explain Spiritualism we are merely putting one unknown quantity for another. But can the passage of thought from one person to another, supposing it fully demonstrated, account for any of the more important of the phenomena upon which Spiritualists build their system? Let us turn to the recent remarkable work entitled "Evenings at Home in Spiritual Séance."* Here the authoress, Miss Houghton, describes the two tests which she accepted as sufficient evidence of the reality of Spiritualism. Miss Houghton, her cousin a Mrs. Pearson, a medium Mrs. Marshall, and the niece of the latter sat together at a round table, and "in a short time the raps came. My youngest sister, Zilla, who died in 1851, was again in conversation with me, and I asked whether anything still troubled her, to which she answered 'Yes,' and on my enquiring what it was, naturally concluding that it would refer to her busband or children, I was surprised by the word 'Helen' being spelt out. Helen was another sister, three years older than herself, who had married a Catholic and had been led away to the same church. This had troubled Zilla on earth, and I felt it was still a grief to her. The name of Helen could never have been the coinage of Mrs. Marshall or her niece, nor was she at all in my thoughts." We must here ask, Was Miss Houghton during this experiment in bodily contact with Mrs. Marshall and her niece? Further, was the thought of her sister Helen unconsciously passing through her mind? If these two questions are answered in the affirmative, it is at least possible that the idea may have passed from the mind of Miss Houghton to that of Mrs. Marshall, and the evidence of the presence of the spirit of Zilla is so far weakened. But in a further experiment, where Miss Houghton is implicitly described as not in contact with the medium, whilst a certain date was given by the planchette, no such explanation seems at all admissible. But there are many so-called spiritual manifestations which, whatever may be their source and their nature, are quite incapable of being accounted for by any transmission of thought between the spectators and the medium. Hence we do not see that mind-reading is likely to do any great things towards the " exposure " of Spiritualism. A reflection here occurs to us: why is mind-reading not, like Spiritualism, proclaimed mere jugglery and imposture, or explained by the rather hazy hypothesis of " Dominant Ideas " ? Surely the evidence in the one case is as trustworthy as the other, and amongst those who have accepted Spiritualism as truth there are men of attainments as high and of integrity as unspotted as any of the advocates of mind-reading can lay claim to! Why, then, do two novelties, each at variance with commonly received doctrines, meet with treatment so utterly different?

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* *See* Journal of Science, Third Series, vol. iii., p. 686.

II. HAUNTED HOUSES AND THEIR PHENOMENA; SUBJECTIVE OR OBJECTIVE?

By FRANK FERNSEED.

MANY persons will undoubtedly pronounce this question utterly beneath the level of a scientific journal. Like the negative philosophers of the last century they will adopt the convenient method of banishing to the realm of fable and delusion whatsoever cannot be explained by their system. From this course I must beg to dissent. The more difficult a subject,—the more it has been complicated by superstition and imposture,—the more clearly it is the duty of Science to search closely and perseveringly into its nature. The difficulties here confronting us are not small. We all have a natural tendency—more or less pronounced—to believe whatsoever is mysterious and inexplicable, just in proportion as it departs from the common run of our experience. The "*credo quia impossibile est*" of Sir Thomas

Brown embodies a deep-rooted trait of human nature. On the other hand, there is in us all a vein of scepticism no less unreasoning than the credulity just mentioned. We are loath to accept, or even to sift fairly, a fact which does not chime in with popular ideas. And these two opposite tendencies do not compensate each other. The mind is like a balance where the centre of gravity lies too high above the point of suspension ; either scale, if it once gets a trifling impulse, may preponderate.

There is in England, at least, another special difficulty. A haunted house is the property of some one. The more a rumour gets spread that No. 19, Alfred-street, is the scene of unexplained phenomena, the more its value becomes depreciated. If I therefore make observations upon such a house, and publish them, I am in a dilemma. If I give the name of the town and of the street the proprietor may bring an action against me for damages. If I withhold all such particulars the reader cannot test my statements, and is entitled to doubt whether I am not playing upon his credulity.

What is a haunted house ? One, simply, where sights are seen, sounds heard, shocks, vibrations, or touches felt, and vague sensations experienced, which cannot be at once accounted for. If such phenomena occur frequently or regularly the house falls into bad repute, the tenants leave, and it remains unoccupied. The cause of the manifestations in question has then to be sought among one out of two groups of agencies :—

a. "Natural." Here we have the deeds and misdeeds of practical jokers, of smugglers, coiners, and other criminals who have got access to vaults and cellars, and whose interest it is to keep the house untenanted. Here also must rank the strange sounds occasioned by rats, cats, insects ; by the wind, by unknown water-courses, or by echoes.

b. "Extra- or Super-natural." Under this head would be classed the manifestations, real or supposed, of the spirits of deceased human beings, of other spirits, or of beings of which the "dweller on the threshold" in Earl Lytton's "*Zanoni*" may serve as an illustration. Or, lastly, the phenomena in question may be conceived of as produced by some man who has acquired powers unknown to the bulk of his species, and who exercises them to punish or annoy some enemy.

c. There is yet a third case : the phenomena are subjective rather than objective ; illusions rather than facts.

We will address ourselves separately to each of these groups.

The extra-natural agencies will be very readily disposed of by adherents of the monistic system. They contend that as there are no spirits, embodied or disembodied, human, superhuman, or infra-human, the phenomena of haunted houses cannot find here their cause. The conclusion is most just, if only we are certain of the non-existence of spiritual beings. But to enter upon the study of the phenomena of haunted houses with this preconceived assumption is, I submit, illegitimate. *A priori*, we have no more right to proclaim the non-existence of spiritual beings than their existence. We must let ourselves be guided and governed by facts observed. But this reservation having been made, there are very grave objections to the spiritual theory of haunted houses. Foremost comes their comparative rarity. If we consider the multitude of persons hourly passing away, and leaving generally behind them both friends and enemies,—if we reflect that in a very large proportion of houses crimes, or at least evil deeds, have been planned or perpetrated, we might expect that "haunting," if due to the return of spirits from the invisible world, would be the rule rather than the exception.

We are told that the scene of a murder is haunted sometimes by the shade of the assassin and sometimes by that of his victim. It is probable that every house in long-inhabited countries stands on or near the scene of some deed of violence committed within the past two or three thousand years. But scarce one family in ten thousand find their peace disturbed by any occurrence of the ghostly class.

Another point is that the number of haunted houses, small as it is, seems to be on the decrease. I know a district, situate to the east and south of Manchester, where, according to the traditions of the past generation, farm-houses, lanes, bridges, and valleys had not unfrequently their mysterious shadowy occupants or visitants. But now the population of that part of the country has risen to perhaps fivefold what it was at the beginning of the century, cases of haunting, instead of having increased in like proportion, have died out altogether. Ghosts and goblins evidently prefer the country to the town.

A curious fact is that Lancashire was, a century ago, exceptionally the home of the supernatural as compared with other districts of England, or—if we except Thessaly, the Harz mountains, and Bretagne—of all Europe.

All these circumstances are, I submit, hard to reconcile with the theory which regards haunting as an objective phenomenon due to the agency of spirits. We may, indeed, be told by a certain school of modern thinkers that we are ignorant of the laws of the spirit-world, and that the points which have just been raised might be capable of a satisfactory explanation. A spirit may indeed be desirous of communicating with the living, but the especial conditions under which alone such intercourse is possible may be wanting. Admitting this plea, the most that can be claimed of us is suspension of judgment, and the readiness to decide any case brought forward upon its own evidence.

Far more perplexing than spirits are the semi-material beings of Earl Lytton, and, if I do not misapprehend them, of the authors of the "Unseen Universe." It is all very well to tell us that as the dry land, the seas, and the air have each their occupants, the depths of space and the inter-atomic intervals may in like manner be inhabited. I reply that all the organisms of which experience tells us are partially at least composed of solid matter, and I confess my utter inability to conceive of portions of liquids or gases being individualised and organised. And if matter exists—as I am not prepared to deny—in any more sublimated state the difficulty becomes greater. I will admit the existence of such beings when I either see them or meet with phenomena from which they may be legitimately inferred.

That strange sights and sounds, as in the case of the "drummer of Tedworth," may be due to the revenge of a necromancer, or, if the term be preferred, of an "occult philosopher," I neither admit nor deny.

We come now to the "natural" agencies by which the inmates of a house may be scared till the cause is discovered. No one can deny that, in numbers of instances, very alarming and apparently inexplicable manifestations have been traced to sources of the most matter-of-fact and every-day kind. To the question, why are haunted houses less frequent in the nineteenth than in the eighteenth or the seventeenth century? the most obvious answer is, because of the greater simplicity and uniformity of modern architecture. The favourite arena for supposed supernatural manifestations was in old castles, monasteries, colleges, baronial halls, not so much because of the deeds of darkness there transacted as on account of their narrow, dark, and winding passages, their staircases concealed in the thickness of the wall, their trap-doors, sliding panels, and other similar devices. Anyone who examines such a building, or even a farm-house of any pretension built in the time of Queen Elizabeth, or in the days of the Stuarts, will be at no loss to understand why it should be haunted rather than one of our well-lighted modern houses, free from all lurking-places and complexities.

Who ever heard of the cottage of a farm-labourer being haunted, save perhaps by typhoid fever? There is not the space that ghosts love; there are none of the closets from which they emerge, or the pillars and projections behind which they may disappear. We can see no reason why the manifestations of truly spiritual beings should be prevented or made more rare by these changes in the style of building. An immaterial being could, so far as we are able to judge, enter a room quite as easily through the solid wall as through a secret door or a disused chimney, and could disappear as readily through the middle of the floor as behind a statue or a column. But we can well understand the facilities which mansions of the mediæval type must give for the transmission of sounds and for the performances of tricksters and criminals.

Even the question why ghosts should chiefly reveal themselves to the sight or hearing of the living at the "witching hour of night," or—to translate the case into the language of men of the world—why strange sights and sounds are most common about midnight, will probably admit of a very natural solution. I have often, when pursuing some train of research to a late hour, been struck with the creaking of wooden articles, chairs, book-shelves, tables, &c. Heaps of papers which have been left in a state of imperfect equilibrium, but have remained untouched for hours, have sometimes suddenly slipped to the ground. I may be told that in the silence of midnight slight noises attract notice which might escape attention amidst the bustle of the day. I reply that in London midnight is a much less silent time than (say) from 3 to 4 a.m. Further, persons on night-duty in mines, where there is no more noise at one part of the twenty-four hours than at another, maintain that the approach of midnight is marked by a general ticking and crackling in all directions, and that loose portions of rock apparently select that time for falling in preference to others.

But a number of considerations lead us to the conclusion that in a great proportion—probably a majority—of instances the phenomena of haunted houses are subjective in their nature, and are due to some illusion on the part of the observer. The facts already adverted to—that haunting decreases with the improvement of domestic architecture, with the increase of population and of intelligence, with better lighting in-doors and out, with the construction of broad open roads not overhung by high hedges and trees; the no less decisive fact that whilst large edifices, public and private, are often haunted, cottages and huts never are—all point in the same direction, viz., to imperfect observation on the part of the witnesses.

We see something in dim light. Then, if our fancy or our fears have been excited by loneliness, by the size, the antiquity, or the traditions of the place where we happen to be, we add, without the least intent to deceive, strange details to the image impressed upon our retina.

Illusions similar to those experienced by Nicolai, and due not to any outward object, but to a morbid condition of the brain, are perhaps more common than is suspected. As far as I am aware no one, on seeing a supposed ghost, has ever applied to it the ingenious test suggested by the late Sir D. Brewster. He pointed out that if we press the eye-ball slightly with the finger any real object placed before us will appear double, whilst any phantom having no substantive existence will remain single.

That by far the greater number of supposed cases of haunted houses, or rather the phenomena on the faith of which such houses are pronounced haunted, must be regarded as subjective is certain; that in a very large portion of the remainder the occurrences on record may be traced to natural intelligible causes is equally decided; but there is a balance upon which it is unphilosophical to pronounce. Let us remember that if an avowed juggler reproduces before our eyes some surprising phenomenon which we have witnessed, this is no proof that the original phenomenon was due to jugglery. A skilful mechanician may make an automaton eagle, duck, or fly. Is this evidence that eagles, ducks, and flies are automata? An adroit coiner may palm upon you a piece of base metal as current coin of the realm. Do you, on discovering the cheat, pronounce all gold spurious?

I may mention an instance of a haunted house related to me by a scientific friend, a gentleman chiefly engaged with the study of physics and chemistry, and very far from credulous. When a youth his family resided for some time in Bretagne, and had taken on lease a house at somelittle distance from a small town. Like many French country seats this house faced on one side—the south in this case—on a garden, whilst the north side looked into a court surrounded by a high wall. In the north-eastern corner was an outhouse, accessible only from the court. My friend, who was then in his 15th or 16th year, occupied a bed-room at the eastern end of the house, looking down into the court. Very frequently before falling asleep he used to see a light passing along the wall of his chamber, but always in one constant direction, as if a person carrying a lantern had left the house by the back door and walked across the court towards the outhouse. Other persons occasionally observed the light from other windows of the mansion, but as if coming in the same direction. My friend, feeling his curiosity much excited, one evening drew his bed close up to the window, so that by merely raising his head a little he could see if there was a lantern being carried in the court. At the usual hour the reflection appeared on his chamber-wall, and when it had passed through about half its course he cautiously peeped out. The court was dark, and the light instantly disappeared from the wall. Much careful examination failed to explain the mystery. The walls and gate of the court were high, and there was not in that direction any house, steeple, or tree overlooking the premises. Moreover, the light always appeared to travel along the upper part of the chamber walls, as if thrown upwards from below. No depredations were ever committed in the house, court, outhouses, or garden.

Several other phenomena of a strange character were observed by my friend and his family during their residence in the house in question, but none at once so easy to describe and so difficult to account for.

We may, I submit, in this case, very fairly pronounce the occurrence as distinctly objective in its character. We may also dismiss the suppositions of trickery, crime, the actions of animals, &c.; but the recourse to the supernatural helps us not the least. We can scarcely suppose a spirit, a "dweller on the threshold," or the like, occupying itself night after night with causing the reflection of a light to travel along the walls of a bed-room!

It is much to be regretted that scientific men are so generally deterred by public ridicule from investigating such phenomena.

III. THE PRINCIPLES OF MAGNETISM.

By Charles Morris.

(Concluded from page 31.)

IN this progress southward from the north pole it could not matter at what point we took the testing magnet beneath the surface, so that a sufficient distance southward was attained. A line of small magnets starting from the pole, proceeding southward over the surface to some point north of the equator, then curving inwards to the axis, and following this to the point of starting, must display a gradual variation in axial direction, until a complete revolution upon the axial plane is effected. And in all such lines possible to form the same result must appear. If this be the case, then the earth, in its northern hemisphere, must form a magnetic vortex, of closed curves of the kind above indicated. These curves would become less in diameter as they were drawn in the interior, and become very small when confined to the region serving as the centre of their curvation. In the southern hemisphere a like magnetic vortex must exist, with the difference that its curves are opposite in direction to those of the northern vortex. These two vortices are separated by the equatorial plane, into which the curves do not enter, but where the magnetic reversion takes place by a gradual weakening and dying out of magnetic energy in the intermediate zone.

Each of these vortices must have its central zone of rotation, to which the north poles of all magnets display a tendency to point in the northern hemisphere, and the south poles in the southern. These central zones must lie between surface and axis, and between equator and pole, and their locality may be indicated by the surface localities at which the magnetic needle stands vertical to the axis, and thus, perhaps, points directly inwards to these interior zones of vortical rotation. If the magnet, in its southward movement, be carried inward at a point north of this locality, its dipping process could not continue, but must be exchanged for the opposite reversion, since it would meet the opposed curve of the vortex. Also if carried south of the equator the same opposition would result. But between the locality indicated and the equator the curvation would regularly continue, except in the neutral equatorial plane which separates the two vortices.

These ideas, differing widely as they do from those usually entertained in regard to terrestrial magnetism, in reality need but one admission for their establishment. Admit that the magnetic needle is really part of the earth, and its magnetism part of the earth's magnetism, and all the conclusions here reached seem to necessarily follow. Its changes in axial position indicate like changes taking place in the earth's magnetism, and could only occur under the astatic influence, as here considered. And, as the single energy of gravitation yields a single centre of attraction, so the dual energy of magnetism must yield two centres of attraction, which all may judge, both from the behaviour of the magnet and from the necessary results of astatic action, to occupy the positions above deduced.

The views of magnetic distribution, as here applied to the earth, must equally apply to all minor magnetic masses. And there is much reason to believe that they do so apply. If we take a large magnet, and place near it a minute testing needle, we discover phenomena similar to those displayed by the earth. At the equator the testing steel sets itself parallel to the magnet. Moving towards either pole it displays the magnetic dip, and, at a certain point between the equator and the pole, it stands perpendicular to the axis. Carried still forward the dip increases, until, at the immediate pole, a half revolution has taken place, and the needle has become directly parallel to the axis of the large magnet, instead of reversely parallel, as when at the equator. These phenomena are not so distinctly declared in ordinary magnets as in the earth, on account of their difference in shape. Magnets are usually elongated, slender masses, and the point where the testing needle stands vertical is nearer the pole the more long and slender they become. When thick and short this point moves towards the equator, until it often assumes a position at one-third of the distance from the pole to the equator. Probably, if the magnet were spherical instead of cylindrical, this vertical point would assume a position similar to that it has in the earth—nearly midway between pole and equator.

It is not necessary that the testing needle be magnetised. Induced magnetism will cause it to go through the same series of evolutions. But does not this lead us to a new conception of the state of affairs existing within a magnet? Magnetism, as we have already considered, does not belong to the mass as a whole, but to its molecules as individuals.

These molecules are really independent bodies, and must exert inductive influence upon each other without regard to the fact that they are combined into the same general mass. A magnet, in fact, is a mass of minute magnets, and in no respect differs in character from the earth as a mass of larger magnets. These molecular magnets seek to force each other into astatic relations; but the local action in a regular mass of magnets of equal energy must be even less efficacious than in the irregularly magnetic earth. The action of induction must become general instead of local with the result that the molecules of the axial and surface regions must set themselves reversely parallel to each other. And the small testing magnet must become, virtually, a molecule of the large magnet, and assume, at every position, the same direction possessed by the molecules at that position. For such a small magnet could no more set itself up as an independent body than could a molecule of the larger mass or a magnetic needle as applied to the earth.

The dip of the small magnet, then, indicates a like dip of the surface molecules. At the point where the small magnet stands perpendicular to the axis the surface molecules must do the same. Beyond this point the continued reversal of the small magnet indicates a continued reversal of the surface molecules. The complete reversal of the small magnet at the pole indicates a like reversal of the surface molecules. Thus the evolutions of the small magnet must indicate a like series of evolutions performed by the surface molecules of the large magnet. These, at the equator, are reversely parallel to the axis; at the pole they are directly parallel to the axis; and at every intermediate point they are intermediate to these two positions.

But this similarity of every magnet to the earth leads us to apply the same deduction to both cases. An interior dip like that we have supposed to exist in the earth must likewise exist in every magnet in which it is not counterbalanced by terrestrial influence. Thus each magnet must virtually comprise two magnetic vortices, whose centres of rotation lie beneath the point of vertical dip, while their superficial curves are separated by a neutral equatorial region. And these two vortices are comprised within a single vortex, which is indicated by the fixed direction of the magnetism of the axis and its complete reversion in the surface of the mass.

This general vortex we can see, by the aid of iron filings, extending itself in significant lines from the equator to the poles of the magnet. The iron filings virtually become fluid exterior molecules of the magnet, and reveal the conditions existing in its interior. Over the equator they extend in lines parallel to the axis. Farther north or south they dip, and eventually become vertical to the axis. This dip increases, until at the poles they stand reversely parallel to their former direction, and in the line of the axis. Throughout the axis this reverse parallelism doubtless continues.

If the magnet be touched to the iron filings these attach themselves strongly to the poles, and weaken in their attachment as they approach the equator, where they fail to attach themselves. From this it is argued that magnetism is strongest at the poles and weakest at the equator; but such a conclusion does not necessarily follow. At the equator the axes of the molecules are directed parallelly to the axis of the magnet. Thus their energy is not exerted outwardly. And as the magnetism of the surface molecules is similar in direction to that induced in the filings, they must repel instead of attracting these. Leaving the equator the dip begins. One pole of the molecule is directed outwardly, and an attractive influence is exerted. This increases steadily towards the poles, at which one pole of the molecule is turned directly outwards. The fact that the molecules and filings are similar in axial direction, which would cause repulsion were they side by side, causes attraction when they are end to end.

We have argued, from the admitted premises, that the magnetism of masses is a combined result of the magnetisms of their constituent molecules. We may now ask, What is the magnetism of a molecule? And in this question a second is involved—What is a molecule? To give the latter its general expression we say—A molecule is an aggregation of atoms. And we shall probably have to seek in these atoms the true origin of the phenomena of magnetism, and the cause of its many variations in strength and character. According to the theories of Ampère and Weber magnetism arises from the flow of constant electric currents around the surface of molecules. The Ampèrian theory is constantly and gravely repeated in text-books, to the present day, without a hint being given of the indisputable fact that it is quite at variance with the principles of energy, as now understood. It is easy to imagine a constant current of electricity, and make it answer a definite purpose, but the truth is that no such thing exists as a constant current of electricity, in the Ampèrian sense.

The current of static electricity is instantaneous. It ceases as soon as the electric equilibrium has been restored.

The current of galvanic electricity consists of a series of instantaneous currents, and ceases when chemical equilibrium is restored. The current of thermo-electricity is likewise composed of instantaneous components, and ceases when temperature equilibrium is restored. Thus electric currents are a consequence of the effort to produce equilibrium of forces, or of heterogeneous motive conditions to become homogeneous, and can only continue while this restoration of equilibrium is in process of being produced. If there were disturbances of equilibrium of force in molecules, they could produce no effect while the disturbed condition continued unchanged. Only while equilibrium was being restored could electric currents arise, and they must cease when this process was completed. Such an action would probably be instantaneous. It is impossible to conceive of any point of a molecule being constantly overheated, or in an unceasing state of chemical change, in spite of the constant effort to restore its force equilibrium. Therefore it is impossible to yield assent to the Ampèrian hypothesis of magnetism.

In fact the constancy and the peculiar relations of magnetic energy can be understood only under the hypothesis of attraction already advanced by the writer. If attraction be a result of the action of motion upon motion, parallel motions attracting, opposite motions repelling, the whole difficulty vanishes. Let us suppose atoms to consist—as advanced in my last article in this Journal—of minute masses of ether, rapidly rotating, and having the form either of spheres, of circular disks, or of circular rings, according to the relations of vigour between their centrifugal and their centripetal energies. If this motion of rotation exert an attraction upon all similar motions, and a repulsion upon all reverse motions, the atom would act as a magnet, this unceasing motion, with its force relations, answering every requirement of the impossible electric currents of Ampère. Every atom would have two magnetic poles of equal vigour, its axis of rotation forming the magnetic axis, and the two poles of this axis the magnetic poles, each of which would attract the unlike and repel the like poles of every other atom.

If such be the constitution and the magnetic relations of an atom, we may ask, What is the constitution and the magnetic relations of a molecule? Twice already, in this paper, the probable arrangement of a mass of small magnets has been considered. It is not necessary again to repeat it. But a molecule composed of magnetic atoms would also constitute a mass of small magnets, which must arrange themselves under the same principle displayed by the magnetic molecules of masses, or the magnetic masses of the earth. Nature, in this particular, must repeat herself in the largest and the most minute masses. The mass of atoms must have a magnetic axis, and a magnetic equatorial surface with the poles of its atoms reverse to those of the axis, while all intermediate atoms must assume the necessary intermediate direction. A molecule, therefore, must be a counterpart of a spherical magnet, or of the earth, its magnetism, when undisturbed, exerting itself inwardly, and only displaying itself outwardly under strong exterior magnetic influence. Whatever the arrangement of these magnetic atoms, and the degree to which their dual energy is masked by their interior relations, they must be susceptible to exterior influences, and this magnetism may be usually made to display itself outwardly. If a magnet of sufficient energy be brought near to masses of such molecules, they will, in the majority of cases, display some degree of magnetic force, precisely as two magnets do when brought close together. This magnetism is induced, and usually disappears on removal of the magnet. Nor is its origin difficult to comprehend under our hypothesis. For the magnets in any homogeneous aggregate must, when free from exterior attractions, feel only each other's influence, and so arrange themselves as to exert all their force inwardly. But on the approach of an exterior magnet this arrangement is disturbed. The magnets seek to shift the directions of their axis so that a portion of their polar energy can be exerted in the direction of the external magnet. But this magnetic action must be conveyed from molecule to molecule, and, where these are too far apart to readily act upon each other's magnetism, only a very vigorous external force can produce a general accordance. Where they are close together, or for any other reason easily yield to each other's influence, they must more readily obey the energy of external magnetic attraction, and with the greatest readiness in the line of greatest approximation of molecules. It need scarcely be said here that the facts of magnetism agree with the above deductions, magnetic substances, with few exceptions, being those whose molecules are closest together, while crystals are most strongly magnetic in their axis of greatest density. In certain cases the magnetism thus induced becomes permanent, the molecules as magnets continuing to affect each other magnetically, and their conjoined magnetism displaying itself outwardly. Thus the action of mass upon mass, in the production of permanent or of temporary magnetism, is the result of the action of molecule upon molecule, they in the one case assuming a permanent, in the other a temporary, magnetic arrangement. It is not improbable that the differences in magnetic energy of different substances arise from two causes only—the original weakness or strength of the magnetism of the atoms, and the degree of contiguity into which they are brought in their compounds. They necessarily act upon each other like separate magnets. If these be close together they control each other's solar direction. Placed at a certain distance apart they fail to control each other's direction. The same rule doubtless holds with atoms and molecules. Thep may. in their incessant motions, frequently come together so close as to mutually control each other, but they must be normally in this intimate relation to yield a permanent mutual control. Thus in one case the atoms of molecules may be so far separated as to feel no permanent mutual influence. In a second case they may permanently act upon each other, and the molecule become magnetic. But again the magnetic molecules of a mass may be so far separated as not to affect each other. In another case they may be close enough together to act upon each other magnetically. But even in this case local action between them seems to hinder general action, and to produce magnetic neutralisation in the mass as a whole. Only when forced into harmony through the energy of a strong exterior magnetism is this local action overcome, and temporary or permanent magnetic relations produced between the molecules as a whole. Astatic relations arise between surface and axis, the equatorial diameter decreases through their mutual attraction, and the polar diameter increases through the pressure exerted.

The relation thus produced between the molecules of a permanent magnet is one that is easily disturbed. Heat, by separating the molecules, overcomes it, local action is resumed, and magnetic neutrality results. Tne influence of exterior magnets also disturbs, and often reverses it. Thus general magnetic relations between molecules is not a normal condition of masses, since it never arises of itself, but always through external influence.

It may be that the diverse magnetic behaviour of different substances is a consequence of the above relations of their molecules. All substances whose molecules are susceptible of assuming harmonious magnetic relations may be magnetic; all whose molecules resist being brought into harmonious magnetic relations may be diamagnetic. For a substance to be magnetic all its molecules must respond to external magnetic attraction, and shift the directions of their poles in accordance therewith. But it may be possible for the molecules to be so related to each other individually that a general conformity of direction is vigorously opposed by those local relations of harmony. As two or more magnets brought together upon the earth's surface affect each other so strongly as to overcome the energy of terrestrial magnetism, and enter into local relations of astatic or general harmony, so it may be with molecules. They may be so combined as to form local groups, in which a certain astatic neutralisation takes place, and thus relieves them from the influence of other, similarly neutralised, groups.

In such a case the molecules would probably resist the influence of a powerful exterior magnetism. It is a question of the balance of vigour between the local relations of the molecules and the vigour of the exterior magnet. In some cases the local relations may be overcome, and a general relation produced, either permanent or temporary. In other cases this general relation may be vigorously resisted, the local action of the molecules displaying the same resistance as the local action of magnets does to terrestrial magnetic energy. In the latter case the phenomena of diamagnetism must appear.

For if the molecules refuse to shift the directions of their axes in response to external magnetic energy, they must in some other manner respond to this energy. The positions of some of them must be such as to render them less resisting than others. In the case of certain crystals, for instance, the resistance is less effective in one crystalline axis than in the others, and the crystal sets axially in this direction. But if there be no such special axis the effect of resistance to magnetic leverage must tend to force the resisting molecules out of the line of magnetic force, until the smallest possible member remained in this line. The mass sets eqcatorially to the magnetic axis.

There is here no repulsion. The effect is in direct response to magnetic traction. It is the result of a strain between external and internal forces. Where the molecules yield individually to the external energy, and shift their polar directions into conformity therewith, the mass must set axially. Where their mutual influences enable them to resist this individual action, the same influence causes them to move bodily, and in such directions as to reduce the conflict between external and internal energies to the smallest sum. The mass sets equatorially. If this be the case, then alike in magnetic and in diamagnetic phenomena the attractive influence of magnetic energy is alone concerned. But in the former case the action of the external is sufficient to overcome the resistance of internal energies. In the latter case it is insufficient, and the traction acts in such a way as to reduce the conflict of forces to the lowest possible level.

IV. BEAUTY IN THE EYES OF AN EVOLUTIONIST.

By F. Ram.

AMONGST the new departures in Philosophy consequent on the discovery, by Mr. Darwin, of the way in which Evolution was effected by means of Natural Selection, it seems inevitable that some change in the older prevalent ideas connected with æsthetics must eventually be included.

Although most persons assume that Beauty, where it exists, is immanent, and is the same *semper et ubique*, difference of opinion on any point being attributed to more or less good taste, such an assumption has not been left undisturbed in the minds of men of a speculative disposition, by whom the question whether Beauty is an absolute quality, or one relative to certain conditions, has been discussed at least since the time when philosophy flourished in Greece. The conclusions arrived at by the best-known writers on the subject are found, however, on examination, to be very conflicting; and I believe that it may safely be said that no satisfactory result has been arrived at by them. One prominent theory is that Beauty resides in "fitness,"—that is, the fitness of the admired object to its place in Nature. This theory, taken as a universal truth, appears to me to be quite untenable, for it implies that we can see no beauty in any object until we have acquired so much knowledge respecting it, and its surroundings, that its fitness is evident to our understanding; which presupposes either an altogether incredible amount of knowledge and capacity of discernment in the mind of the admiring spectator, or else that he is indifferent to the appearance of most of the objects that present themselves to his sight. Nevertheless I think that it may be shown, to all those who believe in Evolution and in Sexual Selection, that the "fitness" theory is true as regards all those beauties which in either sex most impress the minds of the other sex, such beauties being the outward visible signs of certain qualities of body and mind which make an individual to be one of the fittest to survive in its environment.

From the Darwinian theory, that the struggle for existence results in the survival of the "fittest," it appears to follow also that the number of descendants springing from those who, through their superior fitness, survive, must be greater than the number of those deriving descent from the less fit, and also—and this is the fact upon which, I think, that a sound theory may be built—that wherever Sexual Selection prevails (that is to say, wherever either sex can exercise choice in mating) those whose æsthetic taste delights most in the outward indications of the possession, by the other sex, of qualities which go to make up the "fittest," will have more descendants than those whose fancy is better pleased with indications of the possession of qualities which make a person *less* fit. And thus, since the taste will in either case be inherited, there will be a general tendency, generation after generation, to bring the æsthetic taste of a community into strict harmony with the characters of body and mind most proper to the environment.

The environment to which any type of beauty is thus correlative will not of *necessity* be that in which a race is living. It must be that in which its ancestry lived in the past time, during which the taste was being formed; but there will not be this discordance where the whole community has lived in the same environment for many generations. In other circumstances, such as the change of environment caused by permanent migrations, a corresponding change of taste must be in process.

It is well known that the different races of mankind do not agree in their ideas of Beauty. This fact is readily explicable on the supposition that the various environments are the foundations on which the various tastes are built. For those who love to see in the opposite sex those outward indications of the possession of characters which have little value in the struggle for existence, and *mate accordingly*, will have *fewer* descendants than those who fall in love with the visible signs of the possession of such qualities as are pre-eminently useful in the environment.

That this theory must be true as regards every important point can hardly, I think, be doubted by anyone who believes in Evolution by Natural and Sexual Selection. For, supposing that there were any such thing existing as perfect unconditioned self-beauty, the human mind would surely be unable to detect it, unless such beauty is in correlation to the human qualities adapted to the surroundings. Let us take bodily proportion as an illustration of this fact. Say that in man the proportion of stature to chest measurement should be as 7 to 4, and that an artist with a perfect eye for beauty would admire these and dislike other proportions. If they are not also the proportions most likely to lead to success in the struggle for existence, it follows that those individuals who admire the proportions that are so, and *mate accordingly*, will leave more descendants, *inheriting their taste*, than those who have a better artistic eye, and mate accordingly. In the end these latter strains with the correct taste will dwindle in number, generation after generation, down to extinction ; for they will not be able to contend with those who have the taste which is bad in an æsthetic point of view, but good in the purely material one.

I believe therefore that—at least as regards all those principal points of beauty in a human being which most attract the attention of the opposite sex, and the charms of which most engage the pen and pencil of artist and poet—a general *Law of Beauty* may be stated thus :—

> *The visible signs of the possession of those qualities of body and mind which have tended in the environment of a race to the production of the largest number of descendants constitute Beauty among that race.*

So that in an unaltered environment it might safely be affirmed of one hundred persons, of whom it could be foretold that they would have one million descendants after a given lapse of time, that they have a higher average of beauty (in the eyes of the same race) than one hundred other persons who would have one thousand descendants only within the same time ; and that the latter are more beautiful than those from whom eventually few or none will derive descent. This law is limited to the beauty of humanity, as perceived by each race, and to the beauty (in the eye of its own species or variety) of such animals as have had Sexual Selection working amongst them.

If there had never been any Sexual Selection, but men and women had always been joined together on some other system,—say, in order of birth,—the theory would have had no foundation whatever. And indeed in that case there would have been no Beauty,—that is to say, none of those aspects which now in either sex principally attract and delight the eye of the other sex would have been gazed upon with any special admiration.

It must be remembered that man is *practically* a machine, and that his beautiful body is adapted to a work-a-day world. To hear most people talk on the subject, one might suppose that the "human face divine" was made up of "flesh" placed on the bones for the purpose of making up a countenance, whereas it is really composed of muscles which are required to move the jaws. Again, as regards the proportionate dimensions of the body: man's heart and lungs fill his chest, and they and his whole respiratory system must be adapted to the composition of the air which he breathes. In the atmosphere the oxygen is in the proportion of 1 to 4 of its ally, the nitrogen. But if the mixture of these two gases had been different; had the oxygen, say, been equal in quantity to the nitrogen, or had been 1 to 40, or 400, the measurements of man's body must have been altogether different from what they now are. And therefore those who, when gazing on a fine statue, can believe in an intrinsic self-beauty, seem to be driven to a conclusion which jars very much with the widened conceptions of the universe existing at the present day, namely, that the ingredients of the atmosphere were mixed in proportions specially adapted to produce beautifully shaped men and women. And not only so; but even the very mass of the earth itself must also have been regulated on the same grounds; for the density of the air on the earth's surface, and the quantity of oxygen inhaled at each inspiration, must depend on the weight of our planet. So that if Tellus had only been, say, of the same mass as the moon, man's shape must have been quite different from that which we now consider beautiful.

If we now direct out attention to other aspects of the human body, the theory advocated will be seen to be supported by the evidence to be drawn therefrom. The *vera causa* of deep æsthetic emotion is seen as clearly in *Complexion* as in anything. For it will be allowed that a good colour is a sign of health. Now health being an advantage in the struggle for existence, it follows that the possession of it tends, on the one hand, to increase the number of one's descendants, and, on the other, admiration of a visible sign of its existence in the other sex tends to give a numerous progeny to those who have this inheritable taste in force. The "association school" of writers on the subject of Beauty would doubtless say that a rosy complexion charms, because we learn to associate health with it in our minds. But I think it vastly more probable that the love of a fine complexion is purely *instinctive*, and that we should equally think it beautiful if we had been taught that it was a sign, not of good, but of ill health. In fact, those who in past generations had a good eye for the right tint have left many descendants (inheriting the taste), and those who were indifferent to it fewer, if any.

The physiological reason why the beautiful rosy or pink complexion is admired is this:—The red corpuscles of the arterial blood give the colour; and it is they which carry the indispensable oxygen through the arteries to the parts of the body requiring it, so that the good complexion witnesses to the goodness of the respiratory system. If the blood were colourless, and the cheeks were reddened by an effusion of a vermilion liquor, gushing from special glands, and serving no other purpose than that of embellishing the countenance, the argument would of course fall to the ground. But inasmuch as the colour is evidence that the system is well furnished with that gas upon the ceaseless supply of which all bodily and mental activity—life itself—immediately depends from moment to moment, it appears clear that the physical fact creates the beauty.

It is to be noted that Natural Selection has given to woman an uncontrollable knack of showing her blood as much as possible when a *favoured* admirer stands before her, her blushes saying—"See, here is oxygen-laden blood. Do you see these red corpuscles? What a respiratory system your sons by me would inherit!" It is not without significance, too, that this blushing, though involuntary, is (as the Commander of the Faithful is told by his wife in one of the "Arabian Nights Tales") a proof that she loves her male admirer. The red corpuscles are made to attract his attention in proportion to the degree in which the match is *instinctively* seen by her to be desirable, with reference to the viability of her offspring. The blush is the more advantageous from the fact that moonlight is proper to courting—a light in which the cheeks look more pallid than in the light of day.

The much-admired "vermeil-tinctured lip" and "bright eyes" tell of the same desirable physical quality, namely a good circulation of healthy blood.

If space permitted it might be shown that there is a general correlation between the attractions of either sex, and such good physical qualities as would tend, through the æsthetic taste leading to the increased chances of viability in the offspring of persons who have such taste, to the multiplication of descendants. But an allusion only to some of them will perhaps be sufficient to maintain our case. Thus there is evidently a connection between the beauty of an unbroken row of sound white teeth and the use for which they have been required. If our race had always fed themselves by a process of suction instead of by biting there would have been no beauty seen by us in the finest row of teeth—an altogether different feature being the delight of our eyes.

The beauty of a good head of *hair* is connected with the protection it affords. It is true that the head may be covered by some artificial head-dress; but an irremovable covering would be a greater security against strokes of the sun, which may be suddenly fatal without any preliminary warning discomfort, as well as against the atmospheric changes so apt to produce colds. The human back has indeed been deprived of its hirsute covering, but the dangers arising from this loss may have been of less consideration than the advantages thereby gained. The loss was really a gain, as the artificial protection would more than make good the natural one, since it could be more readily cleared of *Epizoa*, and could be shifted when too heavy for the season or sodden with wet.

(To be continued.)

V. SILKS AND SILKWORMS.*

By J. W. Slater.

FOR ages the silk of commerce has been furnished by one silkworm, the larva of *Bombyx mori*. Such is at least the general opinion, though in strictness it must be admitted that five other species of *Bombyx*, all, like the first mentioned, feeding upon the mulberry, exist in a state of domestication in China, Bengal, and Burmah, and that their silk is not unknown in trade. These are *Bombyx textor*, *B. sinensis*, *B. crœsi*, *B. fortunatus*, and *B. Arracanensis.* It is, however, a great mistake to imagine that the power of producing silk in commercial quantities and of useful quality is limited to these six species. Two entire families of moths, the Bombycidæ and the Saturniidæ, secrete silk to a much larger extent than do other insects, and amongst these no fewer than fifty-seven species have been more or less closely studied by Mr. Wardle with a view to their utilisation. The produce of these species is known as wild silk, inasmuch as the insects are not systematically bred in a state of domestication, and fed upon cut leaves supplied to them regularly, but are chiefly collected in the forests. Hence the supply is necessarily limited and fluctuating, and the part which these silks are capable of playing in the arts has not been till lately worthily appreciated.

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* Handbook of the Collection illustrative of the Wild Silks of India in the Indian Section of the South Kensington Museum. By Thomas Wardle. London: Her Majesty's Stationery Office.

It may be asked, What necessity is there for promoting the culture of these silks, and for introducing them into commerce ? To this question there are three sound answers. As the products in question will be, if developed, a source of remunerative employment to the people of India, it is a matter both of policy and of duty to turn them to the best possible account. Again, these silks possess properties in some respects different from those of common silk, so that they suggest novel applications in the decorative arts. Lastly, the supply of silk at present is quite unequal to the demand. Hence has arisen that disgraceful fraud known as "weighting" or "loading." Silks in these days are not dyed for the legitimate purpose of giving them some desired colour, but, especially in the case of black goods, of increasing their weight. The manufacturer when he sends, say, 100 lbs. of silk to be dyed, stipulates that he shall receive back sometimes as much as 300 lbs., the difference being made up by the vegetable and mineral matter deposited upon the fibre. This procedure has become so general that its immoral character is entirely overlooked, and it may perhaps excite the anger of the reader if I pronounce it—as I am bound to do—fully on a level with forgery and coining. In justification of this view I must point out that the value of silk is based upon certain physical and chemical properties which it naturally possesses. It is a very poor conductor of heat and of electricity ; it bears a great strain in proportion to its thickness, and by reason of its smoothness it is less affected by friction than are other textile fibres. It is, further, not readily combustible, and may be pronounced incapable of spontaneous decomposition. Rags of silk buried in the earth, or placed in dung-hills in contact with putrefying matter, animal and vegetable, remain unchanged. It is, further, less easily soiled than linen, cotton, or wool, since dirt does not so readily adhere to its polished surface. In all probability, from the same reason and from the wire-like structure of its fibre, it must be less liable to receive and transmit infectious matter than are other textile materials. All these properties of silk mark it out as peculiarly adapted for human clothing, independent of its lustre and of the beautiful basis which it presents for the finest dyes. But all are sacrificed by the process of weighting. The silks are alternately steeped in decoctions of catechu and logwood, and in solutions of iron—the so-called *rouille* of the Lyon dyers. In addition come solutions of potassium ferrocyanide, for the purpose of depositing a quantity of Prussian blue upon the fibre and counteracting the brownish tint communicated by the other ingredients. At last, after a number of operations, sometimes exceeding twenty, the dyer succeeds in converting the original pound of silk into three pounds of something! That his task is difficult and delicate there is no denying. But so is that of the forger, who, in spite of all the elaborately engraved and coloured grounds till lately in use, succeeds in altering the figures and words expressing the real amount of a cheque, and in substituting others. But our admiration for his skill and knowledge does not blind us to the criminal character of his purpose. We do not see that the "loading" and "weighting" dyer should fare any better, though he is merely the cat's-paw of the manufacturer or the merchant. For what has he effected? He has rendered the permanent, almost incombustible silk not merely inflammable on contact with a match or a lighted candle, but capable of destruction by eremacausis, and even of downright spontaneous combustion, endangering goods trains, ships, and warehouses. Here surely is a laughable instance of human folly. We try, earnestly and perseveringly, to find out some method of rendering cotton and linen tissues uninflammable; but when Nature kindly gives us a material free from this danger, we work in the opposite direction, and do not rest till we have rendered it not merely liable to ignition, but even spontaneously combustible. The very same treatment renders the silk a much better conductor of heat and electricity, reduces its power of supporting a weight or strain, and of resisting friction. Its surface on microscopic examination is no longer smooth and glassy, but rough. Hence it readily takes up dirt, and is soon damaged by wearing. That the lustre and the beauty of the fibre are sacrificed needs no demonstration.

The plea of cheapness is of the less value because the reduction of price to the consumer is never in proportion to the additional profit of the manufacturer, and still less to the deterioration of the goods themselves. We are sometimes told that the public "will have" weighted silks: this is the usual plea of sophisticators. But as public taste has been artfully corrupted, it would resume a more healthy tone if the fraud were at once sternly suppressed. Meantime the best reply to the weighters and loaders is to produce genuine silk in such quantity as to lessen the temptation to fraud. If this desirable end is gained great credit must accrue to the government of India, and, more than to any other man, to Mr. Wardle.

I will now take leave to make a few remarks on the entomological side of the subject. We cannot fail to notice the existence of two hybrid silkworms which are produced not as physiological rarities, but in quantity, so as to be commercially available. The so-called "Ailanthus silkworm" of Europe is a cross between two species of *Attacus*, the *A. cynthia* of China and the *A. ricini* of Bengal. This hybrid was first experimentally produced in France under the care of M. Guérin-Méneville, and has been successfully introduced into various countries. Again, *Antheræa Yama-mai*, of Japan, has been crossed in France with *Attacus Pernyi* of North China, the hybrid insect being exceedingly hardy. These facts are commended to the notice of such writers as still think it necessary to deny the permanent fecundity of hybrids.

Mr. Wardle, in his work, not merely figures several of the most important species in their successive states as larva, as pupa in the cocoon, and as the mature moth, but he has described and figured the scales from the wings of several species. The value of characters drawn from these scales for the distinction of species, or even genera, is very doubtful. Mr. Wardle's figures all show correctly the insertion of the stem or shaft to the body of the scale as it occurs in all the main groups of the Heterocera; that is, the stem is attached, as is the stalk to (*e.g.*) a laurel-leaf, whilst in the Rhopalocera it is inserted in a kind of notch between two projections. But in other respects the scales are of the less diagnostic value, because in different parts of the wing of one and the same species they vary as much as they do in different species: there is moreover, I believe, in every case a double layer of scales, the upper and the under stratum differing in form. Lastly, these scales are easily detached, so that if a moth has struggled on being captured, the scales from different parts of its wings become more or less blended, and two observers in taking portions for microscopic examination can rarely hope to obtain quite identical forms. I have compared the author's figures of the scales of *Saturnia carpini*, male and female, as taken from the middle of the anterior margin of the fore wing, with corresponding specimens from my own collection, and whilst I find the general structure of the scales correctly rendered, I fail to recognise the well-marked sexual distinction shown in Mr. Wardle's plates. His remark that there is no relation between the size of the scales and the size of the insect producing them, or the extent of its wings, is perfectly correct. The statement that there is a correspondence between the size of the scales in any species and the thickness of its thread, I have not had an opportunity of verifying, but it deserves attention. Mr. Wardle gives a table of the diameter, strength, and tension of the fibre of several of the most important silks. There is no mention as to any difference in diameter between the thread of the male and the female in any of the species examined. An error is exposed which has found its way into some entomological works. The two threads which issue from the orifices of the silk-glands are sometimes said to be twisted round each other as they issue from the so-called spinnerets. This is a mistake, as on microscopical examination they are found to be simply laid side by side.

A most important point is the colour of the silk produced by each species : that of the common silkworm is generally white, sometimes more or less verging to a yellow. In the other species the silk is of a deeper colour, verging sometimes towards a green and sometimes to a brown. Hence before the silk can be used in the manufactures, except for some especial deep and dark shades, it requires to be bleached. Here, accordingly, was the first obstacle to the utilisation of the wild silks. The produce of the common silkworm is easily bleached, either by the process of "stoving" —*i.e.*, exposure to the fumes of burning sulphur—or by steeping in solutions of the bisulphites of soda or of magnesia, slightly acidulated with hydrochloric or oxalic acid. In both these methods sulphurous acid is the active principle, and destroys the colouring-matter of the silk by depriving it of its oxygen. But this method of bleaching, so satisfactory with the silk of the common mulberry-eating silkworms, fails altogether with the wild silks. The late eminent technical chemist Tessié du Motay, therefore, tried to bleach them by means of an oxidising agent, and at first made use of permanganate of potash. The brown or orange colouring-matter was thus quickly destroyed, but the fibre of the silk was so much injured as to be unfit for spinning and weaving. He next tried barium peroxide, which in contact with water gradually gives off oxygen and destroys the colour. By this means it has been found possible to bleach the wild silks so that they can be dyed to the palest and most delicate shades. One drawback remains—the expense of the process. The cost of bleaching is 2s. per lb., which is a heavy charge for a material which does not itself cost more than 10s. per lb. Acccordingly experimentalists, and above all Mr. Wardle, are seeking to introduce a process equally effective and more economical. The results already attained are understood to be highly promising, though the details cannot be made public till the process is rendered perfect and has been secured by means of letters patent.

In the meantime Major Coussmaker, a diligent and skilful cultivator of wild silk, is turning his attention to preventing the silk from becoming coloured in the cocoon, so as to do away with the subsequent necessity for bleaching. It is known that the worm or caterpillar hardens its cocoon by means of a certain cement consisting of urate of ammonia, and being, in fact, of an excrementitious nature. Major Coussmaker writes:—“This year, by opening the cocoons at various intervals, I was able to convince myself of the fact that when the caterpillar has left off eating, and begins to spin, it voids the food remaining in the alimentary canal, first of all in a more or less solid form and of a dark colour. but after it has become fully enveloped in the cocoon the excrement comes away as a light coloured liquid, the hue and consistency of which depend upon the amount of vegetable matter not previously evacuated, and the amount of lime, carbon, and ammonia present. The respective proportions of these ingredients vary, I presume, with the food on which the caterpillar has fed, and with the state of the atmosphere at the time of spinning. The longer they remain coating the fibre, the harsher and the more discoloured it will be. It is therefore very necessary, I think, to remove this current at a very early date, and this chemistry has shown the manufacturers how to do. Before long fresh cocoons will be, at an early stage, thoroughly cleansed from all discolouring matter, and the Tasar silk will be available for manufacturing purposes as colourless as when first put forth by the caterpillar.” Major Coussmaker has sent Mr. Wardle a cocoon thus purified, and free from all brown or fawn colouration.

Of the wild silks the most important are the Tusser or Tussah,—more properly written Tasar,—the product of *Antheræa mylitta;* the Eria, yielded by *Attacus ricini;* the Moonga, Mooga, or Muga, from *Antheræa Assama;* and the silk of *Attacus Atlas.* This moth is the giant of the silk-producing families, and measures 10 inches across its open wings.

The wild silks, as may be inferred from the difficulty met with in bleaching them, differ in their chemical behaviour from mulberry silk. A cold solution of zinc chloride dissolves common silk in three days, but has no action upon the Tasar even in a fortnight. The affinity of these silks for colouring-matters is feebler than that of common silk; they take up the aniline dyes better than most other colours.

Mr. Wardle has been especially commissioned by the Indian department to ascertain what dye-wares, natives of India, are best suited for use with Tasar silk. He has got exceedingly satisfactory results with lac, safflower, the leaves of *Phyllanthus emblica*, the calyces of *Thespesia populnea*, the flowers of *Butea frondosa*, indigo, hursinghar flowers, and the flowers of *Œdrela toona.* In the second rank he places a number of colours, among which the best known are munjeet (Indian madder), sapan-wood, and the root of *Morinda citrifolia.* Upon Eria silk Mr. Wardle has produced an assortment of shades which leave little or nothing to be desired. The Muga silk is more easily dyed than the Tasar and the Eria, giving better shades at a less cost.

Summing up the progress that has been effected in the utilisation of these silks, it may be said that their bleaching, dyeing, and printing, though still capable of improvement, have passed the stage of experimentation, and fairly entered upon that of industrial practice. The reeling of Tasar cocoons and the carding and spinning of the other silks have been greatly improved, and practical men—little given to fits of enthusiasm—are discovering that these hitherto neglected materials have before them a great future.

The wild silks also admit of applications hitherto novel, and for which our older textile fibres are less suitable. Thus the Japanese combine upon silk tissues printing and embroidery, thus opening up a new style in art manufactures capable of being greatly extended and diversified. Mrs. Wardle has produced some novel and excellent effects in embroidery upon Tasar cloths. I may here suggest that ladies whose native refinement of taste has been scientifically and artistically cultivated might have a very beneficial influence in the development of the decorative arts.

I cannot help mentioning an unfortunate error, clerical or typographical, in Mr. Wardle's pamphlet. In the scheme showing the position of the silk-moths in the animal kingdom, "arthropoda" has been converted into "anthropoda."

VI. THE "MYSTERY" OF GEOLOGICAL FAULTS.

By Robert Ward.

In the January number of the "Journal of Science" D. Y. C. says that "Faults are one of the mysteries of Geology," and he asks, "Why are faults so often found V-shaped? How has such a phenomenon occurred?" He further observes that "Faults are not wholly owing to district subsidence, or more remotely to shrinkage. . . . It is demonstrable that faults of the same district are not all of the same period. The new formations are found lying unconformably on older formations, *each* with their separate set of faults. And probably under these again would be other sets. I am strongly inclined, therefore, to believe it to be owing to causes ending finally in local compression, or *yielding* fluctuations of strata—waves, in a rough sense, of semi-fluidified strata."

The mystery will be easily solved if we admit that the Earth is a growing body. Faults take a V-shape when two cracks "hade" into each other in reverse directions, and the V-shaped mass of strata between the cracks is often thrown down as the result of a slow separation of the sides consequent upon the Earth's expansion. For the same reason, whenever the strata on the two sides of an inclined crack are found at different elevations, the inclination (or hade) will always take a direction indicative of a separation of the two sides. Perhaps, in some cases, this may be supposed to be accounted for by elevation alone, but certainly it is best explained on the theory that the Earth is a growing body, and that the crack has widened so as to permit of the strata on one side being "thrown down" as contrasted with that on the other. Mr. Wallace, in his interesting work on "The Laws which Regulate the Deposition of Lead Ore in Veins," says that in some cases the strata had been subjected to much tension before it was fractured is a conclusion "which hardly admits of a doubt." Referring to this I have elsewhere observed—"It is obvious that expansion from growth would be likely to have such an effect upon strata of a hard, unyielding nature, which would ultimately crack. Often these cracks (or veins), instead of rising vertically from below, pursue a considerable angle, and sometimes two cracks at no great distance from each other will take opposite directions, so that there is reason to believe that they 'hade' into each other and become one crack at no great depth from the surface. When this occurs, the intermediate strata between the two cracks, which are of a V or wedge form, is usually 'thrown down.' The cracks having widened into fissures by the Earth's expansion, the intermediate strata have slowly 'subsided.'" (*See* "The Constitution of the Earth," p. 362.) Water-courses have nearly in all instances originated in cracks, and although denudation has often played an important part in the existing conformation of valleys, they are mainly the result of an exceedingly slow separation of the two sides of what was once a crack. (*See* the article on 'Scepticism in Geology,' in "The Journal of Science" for June, 1881.) In making the foundations of the unfortunate Tay Bridge, evidence was discovered of what I take to be three distinct cracks, the result of the Earth's expansion. First, the primitive rock has split at a very remote period in geological history, and at the present time we find the two sides separated to the extent of a mile and a half. A gorge, 500 yards wide, was in the first instance slowly formed, which was filled up by sedimentary deposits, including red sandstone, which is now found immediately below the superficial clay. A second crack then took place, by which the red sandstone deposit was separated from the trap on the north side of the river. Over an immense period of time, this slowly widened out to the extent of more than a mile, during which further sedimentary deposits were formed. Between the latter and the red sandstone a third crack next occurred, and this is now filled up by soft material, which gave the bridge contractors a great deal of trouble. It is now about 300 yards wide. In a history of the Tay Bridge, given by Mr. Albert Grothe, we are told that, "after the fourteenth pier had been built, it was found that the rock suddenly dipped to a depth which was practically inaccessible, a discovery which led to a complete change in the mode of procedure. No. 15 pier proved a most unfortunate one for the builders. Like the others, it was formed of two cylinders, but, being founded just where the rock dipped down, it began to cant over after being partially finished, and had ultimately to be blown down, and a new foundation prepared by means of piling." This piling had to be resorted to for six piers. I assume that the " dip down " was the result of the slow wearing down of the sharp sides of the red sandstone, after its separation from the trap rock, which is itself worn down on each side of the river. As a rule the harder rocks are the older. Consolidation may be said to be a law on this planet of ours, whether we follow the history of an animal, a plant, or a rock.

D. Y. C. says that " The new formations are found lying unconformably on older formations, each with their separate set of faults. And probably under these again would be found other sets." A striking evidence this of the truth of my theory of the Earth's expansion. It is only the more or less hard and brittle rock that cracks, just as only the dry bark of the older trees cracks as the result of their growth. Each particular rock or stratum has had its own history, during one period of which it formed the surface of the Earth, and when it may have been affected by the more demonstrative evidence of vital action in the shape of earthquake waves.

ANALYSES OF BOOKS.

Records of Sport and Military Life in Western India. By the late Lieut.-Col. T. G. Fraser. With an Introduction by Col. G. B. Malleson, C.S.I. London: W. H. Allen.

With the introductory portion of this interesting book we shall concern ourselves merely by noticing Col. Malleson's assurance that the author was eminent for the virtue which scientific men value above all others—truthfulness. The first incident which we shall extract is one which in these days of revived occult philosophy will seem eminently worthy of notice. The author records the strangely fulfilled predictions of a Fakír, or mendicant devotee. The story was told him by the widow of a general merely designated by the initial W., doubtless well known at Bombay about A.D. 1823. The devotee, meeting Mrs. W., said to her—" 'You are the wife of the General Sahib; you have a son and a daughter.' 'I had,' I remarked, 'but I have lately lost the former., 'No,' said the man, 'it is as I say. You are about to leave this country and go to your own.' (Now, I must here remark, my husband had repeatedly declared his intention never again to leave India.) 'Shall we arrive safe?' 'You will, but in fourteen days after you leave here he will be in the hands of God! In eighteen days you will be on board, and will leave everything here to be sold but one horse.' 'Here,' I exclaimed, 'is the stable, with several horses; show me the one he won't sell.' Running his eye rapidly down the line 'That one,' pointing to a grey, a birthday present from the General given me two days before. 'Shall I get home and see my child?' 'Yes,' said he, 'you will see your son as you are leaving this, but shall not speak to him; he will wave a cloth at a distance. You will arrive in Europe, remain there for a time, but your trouble for money will compel your return here; but you will again go back, and after a time your money will come, and you will be happy.' " This prediction was fulfilled to the letter. The same evening the General informed his wife of his intention to return to England. Everything was sold except the grey Arab. When passing the lighthouse a boat appeared vainly trying to overtake the ship, and with a glass a man was seen waving a handkerchief. It proved to have been the lady's son whose death had been falsely reported. In ten days from the time of sailing the General suddenly fell upon the deck and expired, as had been predicted on the fourteenth day.

We shall add no comments, but merely quote Col. Fraser's declaration that Mrs. W. was a truthful lady, and totally free from superstition.

In a later part of the book an account is given of a Fakír who, at the court of Ranjit Singh, allowed himself to be entombed alive, and was resuscitated after the lapse of six weeks. As this incident has been repeatedly recorded, and has, so far as we are aware, never been called in question, there is no need for its repetition. We merely remark that here is a case of fasting much more signal than that of a late "Doctor."

Among the few facts on animal life here put on record must be mentioned the following, showing the tenacity of the black buck antelope of the Dekhan:—"A fore and hind leg, both fore or both hind legs, broken, these animals will still test your horse severely ere you can capture them; and I have seen a deer pass over more than 200 yards of rocky ground before he succumbed to a ball through the centre of his heart."

The author observed a striking instance that venomous serpents do not, as Waterton maintained, invariably confine themselves to defensive warfare. A dog barked at two cobras, which were in a field. "The snakes, immediately untwining, pursued the dog, which ran into the water. The snakes followed him instantly, and, swimming up to him, bit him so viciously that he died in half an hour." This is an interesting fact in snake lore.

Col. Fraser mentions a kind of wild dogs which run down deer in packs. He did not succeed in shooting one, but describes them as "somewhat smaller, but stouter built, than a jackal, a reddish brown inclined to black about the knees and feet."

Serpent-charming is described. A professional charmer was sent for to some outhouses in which dogs and poultry were sometimes found dead in the morning. The man was searched, in proof that he had no tame snakes secreted about his person, and then went to work. "He examined the rat-holes, and, selecting one, he commenced piping a reedy monotonous treble for some five or six minutes, when a cobra's head slowly emerged from the hole. With a forked stick he at once pinned the snake to the ground, and seizing it with the other hand behind the head, drew him gently out of the hole." In another shed the charmer captured another cobra in a similar manner, and put both into his basket. In proof that the man had actually enticed unsophisticated snakes from their retreats, he presented a fowl at the opening of the basket; it was bitten, and died in a few minutes. Moreover, the jaws of one of the snakes were opened for the inspection of the regimental surgeon, who clearly recognised the poison-fangs.

Of the prowess and ferocity of the tiger we find some fearful instances. One man is described as bitten at once through the shoulder-blades and the chest; another had the upper half of his skull bitten cleanly off, "as with a hatchet." Tigers frequently bear the marks of old gun-shot wounds about them. It is a pity that, in dealing with such destructive animals, sportsmen do not see the necessity of using poisoned bullets. In like manner cobras might be routed from the vicinity of houses by the application of carbolic acid.

Rabies among jackals is noted as of common occurrence, Col. Fraser having shot one in this state which had entered his bungalow, and concealed itself under a chest of drawers. Pariah dogs also suffer from this malady, and communicate it to men. These facts are of some importance, since our English dog-worshippers maintain that rabies would disappear if dogs were not chained up and muzzled. The utter vanity of this contention is proved by the frequency of the disease among wild Canidæ.

Mention is made of the sudden and unaccountable appearance of cholera. Thus on a Sunday morning, in 1846, at Karachi, "all were well and healthy. A small lurid cloud was observed over the Biluch hills, the surgeon was called out from church, and by twelve that night a hundred cholera patients were in hospital: it lasted a week, and entombed seven hundred Europeans.

Another epidemic took place at Kolapur. A body of five thousand soldiers were encamped in the vicinity of the town, on a rising ground with a hard gravelly soil. On its flank was the escort of the Commissioner to which the author was attached, merely divided from the main body by a small rocky ravine, and having a large tank in its front. The first evening cholera broke out in the main camp, and on the third day the troops shifted ground after losing one hundred and fifty men daily. Meantime not a single case occurred either among the escort or in the town. If any contagion was being conveyed in the air, why were its effects so limited? Whether we suppose the *materies morbi* gaseous, or consisting of "figured" germs or spores, would seem to make little difference.

One more passage necessitates our attention. The author, "often and bitterly," had to lament his want of even rudimentary instruction in chemistry, geology, and botany." We have altered this matter: we do not "instruct" our officers and civil servants in the natural sciences, but we examine them therein, and thus delude both them and ourselves.

Every reader will, we think, like ourselves, lament that this book is not longer. Col. Fraser could doubtless have told us much more that would have been well worth reading.

The Ruling Mind manifesting itself in the Natural and the Supernatural. By A Student of Nature. London: Hamilton, Adams, and Co.

This little work, though laying no claim to originality of thought or to scientific exactness, deserves much commendation for its clear and attractive style, and for the skill displayed in the development and illustration of its principal argument. It is divided into three sections, entitled respectively—"Has God forsaken the Earth?" "The Hand that never is Weary," and "The Outstretched Arm."

In the first, various processes of growth and secretion, such as the germination of a grain of wheat and the formation of a bird's feather, are lucidly described. The inference drawn is that the selective and formative power exercised by "Nature" can only be the attribute of a conscious and intelligent being, whom we must therefore regard as "the all-pervading Mind" or "the *actual present* Worker in the organic world around us."

In the second division "will be found the fundamental principle upon which the main argument rests—that all motion must necessarily be due to Mind, whether the motions be great or small; the most important illustrations of which, however, are to be found in the grand, unceasing, and generally inscrutable forces of Nature." This hypothesis—for, though stated in the form of an axiom, we can give it no higher rank—is of course supported by the supposed analogy of human volition, and illustrated by the facts of gravitation, and by other natural phenomena.

The third part is devoted to an argument in favour of the possibility and probability of "Miracles," founded upon the considerations adduced in the two former sections.

It will be seen that the teleology here expounded rests upon one great assumption, with which it must stand or fall. To those who deny the dual nature of man, and the government of Matter by Spirit, all this ingenious fabric of analogical reasoning will seem but a baseless and "unsubstantial pageant." For instance, the author asserts, as though it were a self-evident fact, that matter is, *per se*, incapable of thought, sensation, and desire, and therefore of purposive combinations. Surveying the organic and inorganic world, and finding throughout both traces of the adjustment of means to ends, he is forced by his preconceived idea to conclude these are manifestations of an omnipresent Spirit, distinct from the matter which it governs and the subordinate minds which it inspires. We will not here comment upon the inconsistency of a theory which represents the Supreme Being as at once finite and infinite, omnipresent and working by instruments or agents.

It is enough to remark that the results of modern physiological and pathological research, combined with the every-day phenomena of life and death, prove the material brain to be a source of thought, feeling, and volition, beyond which neither reason nor experience can enable us to penetrate. Mind must, therefore, be considered as a function of matter, and as a result, not a cause, of that inherent energy which is manifested in the divers forces of organic and inorganic Nature. If what we call "design," as displayed both in human actions and in the seemingly azoic Cosmos, be regarded as of purely material origin, and not *caused*, though sometimes *accompanied*, by consciousness, the path is open for a theory of Evolution, in which Natural Selection and the Struggle for Existence would be only subordinate, though very powerful factors. The fallacy of such "demonstrations" as those relied upon by "A Student of Nature" consists in the assumption that matter is essentially passive, while all experience shows it to be in a condition of unceasing activity. He is of opinion that the motion of matter "must have had a commencement," but forgets to state the ground of his belief. Admitting that "it has not yet been proved that life is a distinct entity," he yet makes this claim for "mind," which is only a convenient name under which we group certain vital phenomena.

The usual arguments from "Personal Identity" are brought forward, and may be met by the usual answer. Memory is but one among a whole class of phenomena, most of which cannot be referred to spiritual unity. Old scars are retained through gradual changes of material, and even of form. The plant and the animal reproduce themselves in their offspring, which frequently manifest traits of individual resemblances to direct or remote progenitors. Yet it will scarcely be contended that the spirit of an ancestor can be propagated through a long line of descendants, perhaps remaining latent for generations, till it reveals itself at last in the great-great-grandson!

Facts like these are inexplicable; but so, indeed, is the universe of which they form a part: and we must earnestly deprecate the tendency to seize upon a supernatural *rationale* whenever a natural one does not immediately present itself. False metaphors and misleading illustrations, tending towards the personification of the laws and forces of Matter, have doubtless been too often employed by men of Science; and these our author does well to expose. His book may be read with pleasure and profit by those whose theory of the Cosmos differs most widely from his own.—C. N.

Experimental Researches into the Properties and Motions of Fluids, with Theoretical Deductions therefrom. By W. Ford Stanley. London: E. and F. N. Spon.

We have here before us the results of a prolonged and laborious inquiry into the theoretical conditions of the fluid state and the motive properties of forces in fluids. The author, some years ago, appears to have undertaken an experimental examination of the undulatory theory of light, and, as this theory is generally illustrated by similitudes taken from water-waves and sound-waves, he was led to examine these latter motions to be assured that the illustration is not misleading. He accordingly set about observing the motive effects evident in the directions taken by impressed forces in fluids under various principles of resistance. He came to the very legitimate conclusion that much work remains to be done before the principles of hydro-dynamics can be fixed with the needful precision. Some of this work he has attempted to do, and the results are presented in the present volume.

The first three chapters Mr. Stanley admits to be "speculative, and even in parts hypothetical."

In the second chapter, dealing with the conditions of liquid surfaces, he rejects the theory of tensile surfaces for liquids as recognised, *e.g.*, by Clerk Maxwell, and takes the opposite view, that such surfaces are *extensile* instead of *tensile*, "except for free films which are clearly tensile by the position of the attractive matter which composes them." These terms "tensile" and "extensile" he defines as follows:—"By *tensile* I intend a disposition of the parts of a system of matter to draw themselves together as a stretched drum-skin does. By *extensile* I intend the reverse of this, or the disposition of the parts of a system of matter to separate, and thereby to engender external pressures." He considers that his view is supported by the familiar experiment of floating a needle upon the surface of a vessel of water. He pronounces the subject, however, insufficiently worked out.

Some of the propositions in the third chapter will also, it is said, need partial correction. We notice especially the author's 106th proposition, which runs that "a projectile or a flowing force forming the head of a current before the continuity of projection can rotate a large volume of the resistant fluid laterally, will divide its direct current by constant bifurcation until the projectile force becomes in equilibrium with the forward resistance." This proposition he proves, or at least illustrates, by the following experiment:—"Take a pen full of ink, and place this gently upon the surface of the water in the trough (*i.e.*, a glass trough, narrow in proportion to its height). The ink, as it descends slowly by gravitation, will be found to divide constantly upon the conic resistance which opposes its direct descent, the divided parts having insufficient momentum of projection to move the lateral fluid tangentially. After the first division the divided parts again divide, and these again, so that by this constant division and subdivision the projected fluid takes a tree-like form." In the author's illustration accompanying this description there appears, in fact, a series of regular bifurcations. On repeating the experiment with the blue aniline ink we always use, the result was different; the ink descended to the bottom of the trough in a long, very slender, thread, without any division at all. We then made several experiments with common black ink; we obtained results more like those figured by Mr. Stanley. There was division and re-division, sometimes into two, and at other times into three, branches.

The author endeavours to trace a similar action in the organic world:—" Such, for instance, as we find present in diffusion of liquids in the animal body, and the vegetable also under certain conditions; possibly more especially in the early development, or *setting out*, as it were, of the circulatory system. The principle of diffusion here demonstrated may prevail in the formation of the circulatory system within animal tissues,—that is, assuming the animal to be at first in a fluid or semi-fluid state, formed of matter possible [? capable] of after coagulation to the set form we witness. The intrusion of blood or other liquid with small force would of itself, by the natural fluid forces here defined, open out, through any inequality of resistance or by a constant pressure in one direction, a *reticulated system*, which would not only be composed of canals for the future transmission of the fluids, but the forms of such canals would be the least frictional for a constant flow through them afterwards."

In illustration, the author gives a microscopical view of the injected arteries of the bladder of the shrew, where bifurcation may in the main be recognised. The same form may, he contends, be traced in the veins of the liver, of the brain, of the mammary glands, and of certain tumours. This revival of iatro-mathematical speculation may be found worth a closer examination.

The author considers that plants have some power of engendering motive forces in the air for their own sustenance.

We hope that the specimen given may induce scientific men to examine for themselves a work full of suggestions which must interest the geologist, the meteorologist, and the chemist. The author's style is at times obscure, as may be seen from one at least of the passages we have quoted.

Bulletin of the United States Geological and Geographical Survey of the Territories, Vol. VI., No. 2. Washington: Government Printing-Office.

This issue opens with an Annotated List of the Birds of Nevada, by Dr. W. J. Hoffmann, with remarks on the distribution and vegetation as affecting the Avi-fauna. It is only natural that the fauna, both of birds and insects, should depend more on the character of the flora than on absolute height above the sea-level. In Nevada the common humming-bird (*Trochilus colubris*) occurs at an elevation of 9700 feet.

Next follows a List of North-American Moths, with a preliminary Catalogue of the Genera *Hadena* and *Polia*, by A. R. Grote.

Mr. J. H. Scudder has drawn up an account of the Tertiary Lake-Basin at Florissant, Colorado, one of the richest localities in the world for fossil plants and insects. Mention is made of a grove of petrified trees, probably Sequoias, which were formerly from 5 to 6 yards in height, but have been gradually destroyed by tourists. At the southern lake a section of about 7 yards was cut showing thirty distinct layers of shales, many of them fossiliferous. This locality has in a single season yielded more than double the number of specimens which Prof. Heer obtained from the Œningen beds in thirty years. The different orders of insects are by no means represented in the same proportions. At Œningen the Diptera form only 7 per cent, whilst at Florissant they rise to 30; the Hymenoptera are only 14 per cent in the former, and 40 in the latter. The Coleoptera are 48 per cent at Œningen, and only 13 per cent at Florissant. Among all the Florissant insects ants are the most numerous—mostly Formicidæ, a few Myrmicidæ, and some Poneridæ, but no Mutillidæ. Thirty species of Vespidæ have been detected; one, a *Polistes*, shows traces of a blue-green metallic colour. Only five butterflies have been found, generically distinct from any living forms, and there are perhaps eight species of nocturnal Lepidoptera. Among the numerous Diptera, Culicidæ, Chironomidæ, and Tipulidæ are abundant. Bibionidæ are the prevailing type. There are about fifty Asilidæ, some of them of great size. Of the Coleoptera two-fifths belong to the Curculionidæ. There are about thirty species of Carabs; no large Dytisci; thirty Lamellicornes; about as many Buprestidæ, some of which are very perfect. There are about forty species of Elateridæ, often in beautiful condition. There are some fifteen species of Longicornes; perhaps two dozen Chrysomelidæ, and 120 Curculionidæ. Hemiptera present a great variety of forms, but water-bugs, like water-beetles, are uncommon. There are about eight species of plant-lice. The spiders are uninteresting, and have few features in common with those found in the Prussian amber.

These remains, especially the presence of Termites, point to a much warmer climate than that of Florissant at the present day.

The next memoir is a division of the genus *Sciurus*, by Dr. E. L. Trouessart.

The two next papers—the Osteology of the North-American Tetraonidæ, and the Osteology of *Lanius Ludovicianus* var. *Excubitorides*, both by Dr. R. W. Shufeldt—we have already received by the courtesy of the author, and have noticed them accordingly.

There are further included in this volume a review of the Miocene Rodents of North America, and of the Canidæ of the Loup Fork Epoch, by E. D. Cope; and a paper by A. S. Packard, on a Crayfish from the Lower Tertiaries of Western Wyoming.

Osteology of the North-American Tetraonidæ. By Dr. R. W. SCHUFELDT, U.S.A.

THIS pamphlet is a reprint from the "Bulletin of the United States Geological and Geographical Survey" (Vol. vi., No. 2). The author, in the memoir befores us, confines himself to the family of the Tetraonidæ, or true grouse, as distinguished from the Odontophorinæ, the partridges and quails. In grouse North America is very rich, having representatives of the six genera *Tetrao*, *Centrocercus*, *Pediœcetes*, *Cupidonia*, *Bonasa*, and *Lagopus*. The author makes a very complete examination of the osteology of characteristic species of these six genera. His principal conclusion is that though—if we judge solely by outward appearance and structure—the American Tetraonidæ are well classified as they stand, yet that, judging from a purely osteological point of view, there is no valid reason why *Pediœcetes* and *Cupidona* should be referred to distinct genera. In their skeletons they are closely alike, whilst differing to a very marked degree from the other genera of the family. With commendable caution the author proposes to defer judgment pending a full examination of the structure of these birds in other respects.

Such monographs as the present are literally priceless data for the systematic naturalist.

We must call particular attention to the excellence of the illustrations.

Proceedings of the Bristol Naturalists' Society. New Series, Vol. III., Part 2. Bristol: J. Fawn and Son.

We have again the pleasure of finding the "Proceedings of the Bristol Society" containing, or rather composed of, sound, sterling, creditable matter.

Mr. W. J. Fuller, F.C.S., communicates some interesting results on the breathing apparatus of certain aquatic larvæ, chiefly Libellulidæ, but also including the Dipterous genera *Corethra* and *Chironomus*. In *Agrion*, *Libellula*, *Ephemera*, and *Corethra*, but not in *Chironomus*, the breathing apparatus serves as a means of locomotion.

Dr. Sylvanus Thompson attacks a very interesting physiological problem, to wit, by what means do we ascertain the direction of any sound which strikes our ears? This faculty, we may remark in passing, is possessed by certain of the lower animals, *e.g.*, cats, in greater perfection than by ourselves. He describes a number of curious experiments on the localisation of sound, but concludes that it is as yet impossible to decide "whether difference in phase, or direction or quality of the sounds that reach our two ears, is to be regarded as the criterion by which we judge of their direction."

Mr. J. Walter White gives some very sensible remarks on the preparation of a local flora. It is much to be regretted that the phyto-geography of England was not mainly completed a century ago. Since that time numbers of native species have disappeared from their localities in part owing to cultivation and building, but perhaps still more in consequence of the rapacity of collectors and plant-merchants. We quite agree with Mr. White that the localities of rare plants should not be too precisely indicated. We have known of collectors who were not so much anxious to obtain specimens of a rare plant as to leave none behind them, and who consequently would systematically root out every trace of the species in question in some locality.

Mr. C. Jecks, in a paper on "Darwinism," upholds Natural Selection as if not the principal cause of the rise and decay of species, yet one of considerable importance.

Mr. O. Giles describes the boulders of the Bromsgrove district, derived, it appears, from the Arenig mountains.

Mr. A. E. Hudd continues his catalogue of the Lepidoptera of the Bristol district.

Mr. C. Bucknall resumes his account of the Fungi of the Bristol district, and gives several species new to Britain. His memoir is illustrated with well-executed coloured plates.

Dr. G. F. Burder summarises the results of modern investigations on the course of storms. He points out that during January, 1880, there was no atmospheric disturbance of moment in Western Europe, from the 4th to the 27th day inclusive. Yet during this same interval *nine* storms were announced from America as "threatening the British, French, and Norwegian coasts." He quotes from Prof. Loomis an amusing instance of a storm-centre which started from a spot to the south of Greenland, and moved for some days in a regular course eastwards; then turned back, and after a fortnight was not far from the point where it arose; then taking a fresh start eastwards, it finally reached the coast of Norway.

M. A. Leipner, F.Z.S., the able and zealous Secretary of the Society, communicates "A Naturalist's Ramble in Guernsey." He regrets the absence of a local Naturalists' Society, which would find ample work, especially in Marine Zoology. No fewer than sixty-two species of Polyzoa were obtained in one dredging expedition of four hours! The island would be an admirable locality for a station like that of Roscoff, and for an aquarium in the true sense of the word.

A passage copied from the "Beaufort Courier" (South Africa) describes the successful use of ipecacuanha for the bites of venomous serments, including the "puff-adder," which, we belive, is a *Naja* akin to the cobra of India.

Another South-African paper, the "Frontier Guardian," gives a curious account of a battle between a crow and a serpent of the "ring hals" species, in which the former was victorious. It is stated that about twenty other crows were present as spectators, taking no part in the struggle, but testifying their pleasure at the final success of their companion by loud cawings.

We must again congratulate the Bristol Naturalists' Society on the work it is doing, and on the character of its "Proceedings."

A Manual of Sugar Analysis. Including the Applications in General of Analytical Methods to the Sugar Industry; with an Introduction on the Chemistry of Cane-sugar, Dextrose, Levulose, and Milk-sugar. By J. H. Tucker, Ph.D. New York: D. van Nostrand.

Considering that we are, nationally, the greatest sugar consumers in the world, and might be if so disposed—with the single exception of Brazil—the greatest sugar-producers also, the little attention which has been paid in this country to the chemistry of so important a substance is a striking instance of apathy. That we should have to derive instruction on such a subject from any continental nation would little have been dreamed of by our ancestors in the last century. Everyone knows that beet-root sugar was originally one of the weapons devised against England by the first Napoleon. On his fall it was not laid aside, but was vigorously wielded by several countries. The new manufacture was fostered by protective duties and by export bounties, but, above all, its rise and progress were due to technological skill. Every point of the chemistry of sugar-making and refining was carefully and perseveringly studied, whilst we looked on in indifference. The consequence is that our rivals have at last brought forward a product which, if from some hidden cause less pleasant to the taste, appears analytically on a level with the best produce of the cane.

The work before us is designed to furnish English readers with the needful information on the analysis of sugars, saccharine juices, syrups, &c. The author begins with the chemistry of the sugars in general, and proceeds to saccharose, the sugar of the cane, and, as is generally supposed, of the beet-root, though doubts on this head are beginning to arise. Mention is made of strontium sucrate, formed by adding the hydrate of strontia in a solution of sugar, but we do not find a notice of the use of this earth as a substitute for lime in sugar-refining.

Dr. Tucker next passes on to dextrose, levulose, and invert sugar. He then discusses the determination of the specific gravity of saccharine solutions, introducing Baumé and omitting Twaddle. We find next the optical methods for the determination of cane-sugar, the requisite instruments being described and figured. He then proceeds to the chemical methods for the determination of cane-sugar ; the instructions for the determination of dextrose and invert sugar, and for the analysis of raw sugar, treacle, cane and cane-juice, beet-root and its juice, and, lastly, the waste products, are quite on a level with the latest researches, and if they may—as we suspect—not work quite satisfactorily the fault lies not with the author.

Notice is taken of one of the growing frauds of the day—the use of starch-sugar or corn-sugar in adulterating raw sugars, syrups, honey, preserved fruits, sweetmeats, and a long list of other eatables. Nor must beverages here be excluded, since wines are now often made by fermenting a solution of starch-sugar upon the marc of pressed grapes. One of the most critical symptoms shown by society as organised on the industrial type is the tendency to apply every invention to fraudulent purposes.

Dr. Tucker's work fills up an important vacancy in the chemical literature of our common language, and will doubtless meet with wide appreciation.

Report of the Entomologist of the United States Department of Agriculture for the year 1880. By J. H. Comstock. Washington: Government Printing-Office.

In the United States, much more than in any other country, the damage done by insects to various crops is being closely scrutinised, and the habits of these destroyers are carefully studied with a view of finding out means of limiting their ravages. Whether this judicious activity is due simply to the practical good sense of our Transatlantic neighbours, or is forced upon them by the fecundity of certain insect species under their warm summer suns, it is not necessary to inquire. But we may safely assume that the investigations of Mr. Comstock and his colleagues will be of great service to agriculture all over the world, besides bringing in a rich harvest of purely scientific observations. One of the facts most frequently forced upon the mind, in reading these reports, is the mutability of animal habits.

Closet-naturalists of the old school, and even some out-door observers who confined their researches to some limited sphere, always tell us that every animal species is placed by Nature in the locality best suited to its existence and propagation, and that its choice of diet and general habits are dependent upon primordial and unvarying instincts. In contradiction to such statements we find that a species on finding its way into some new region flourishes and multiplies to an extent unknown before. An insect may have long been recognised in Europe as practically harmless. Take it to America, and it may become a serious nuisance.

In the volume before us a remarkable change of habits is recorded in the scolytid beetle, *Monarthrum fasciatum*, which perforates the heads and staves of casks, letting the contents leak out. Formerly these enemies were kept at bay by painting the casks with white lead, but "latterly they hardly wait for the casks to dry before commencing their attacks."

The greater part of this report is taken up with a thorough examination of the Coccidæ, or scale-insects, a tribe very destructive to vegetation in tropical and semi-tropical countries, and which are unfortunately cherished and defended by the ants, which even re-introduce them on trees where they have been destroyed. Mr. Comstock considers soap-lye the most effectual remedy.

Geological Survey of Alabama. Report and Progress for 1879 and 1880, By E. A. Smith, Ph.D., State Geologist. Montgomery: Allred and Beers.

The principal feature in this report is the exploration of the coal deposits of the Warrior Basin. In a section of 2600 feet there are from thirty to thirty-five seams of coal, of different thickness and quality. Many samples have been analysed, and the sulphur is found to vary from 0·4 to 2·75 per cent. The latter quality, if extensively used, cannot fail to have a very injurious effect on vegetation, from the quantity of sulphurous acid poured into the atmosphere.

The Whole Art of Marbling, as applied to Paper, Book-edges, &c. Containing a Full Description of the Nature and Properties of the Materials used, the Method of Preparing them, and of executing every kind of Marbling in use at the Present Time; with numerous Illustrations and Examples. By C. W. Woolnough. 82 pages; 31 specimens. London: George Bell and Sons.

The marbled papers so commonly used for the linings and covers of books are familiar to everyone, but very few have any idea of the process by which the curious, irregular, but often delicate and harmoniously coloured, patterns are produced.

The former edition of Mr. Woolnough's book, published more than twenty-seven years ago, has for some time become very scarce, and many improvements have taken place during that period which are embodied in the present issue.

The exact date of the introduction of marbled paper is unknown, but it is found on old Dutch books of the beginning of the seventeenth century, and was known in Spain at least a hundred years ago. This country was formerly supplied from Holland, a considerable quantity of the paper finding its way here wrapped round parcels of toys, and by this means of importation escaping the payment of a very high duty.

The author explains very much in detail the whole of the implements and materials employed, many of which, especially the colours, require great care both in selection and preparation.

The process may be described as a peculiar kind of printing, the impression being taken on the paper from the surface of a mucilaginous fluid, by being carefully laid upon it after the pattern has been prepared. The medium used is generally gum tragacanth, which, when soaked in water, does not entirely dissolve, as is the case with gum Arabic, but forms a somewhat gelatinous mass: this solution is, for certain patterns or for the sake of economy, sometimes modified by mixture with the mucilage extracted from various seeds by soaking in hot water.

Upon the surface of a bath thus prepared, the colours—which are ground in water and tempered with a wax medium, partly to fix the colours on the paper, and partly to facilitate the glazing process used in completing the paper—are thrown or sprinkled, according to the effect to be produced, each succeeding colour having a little more ox-gall mixed with it, which causes it to spread and drive before it the other pigments in which the proportion of gall is somewhat smaller, the result being a surface covered with variously coloured spots and veins: these, in some patterns, receive modifications by combing and curling with a few simple tools.

The examples of paper in various progressive stages assist greatly in the understanding of the various modes of working—a matter rather difficult to understand without such assistance. The specimens given are numerous, and the reader cannot help being struck with the great beauty of many of the patterns.

Mr. Woolnough considers that there is much scope for further progress in the art, and that chemistry might be pressed into its service with every probability of discovering new means of working.

A detailed account is given of the way of making the whole of the patterns described in the book.

CORRESPONDENCE.

⁂ The Editor does not hold himself responsible for statements of facts or opinions expressed in Correspondence, or in Articles bearing the signature of their respective authors.

DISUNION IN THE CAMP: VIVISECTION.

"The public must be educated. . . . The claims must be definite. It must be clearly understood *that the right we contend for is not that of* FREE '*vivisection,' free alike to the student and teacher, the tyro and skilled experimenter. Nor do we claim the right of vivisection for the mere purposes of demonstration.* But we do claim that skilled experimenters—physiologists, pathologists, and pharmacologists—shall have perfect freedom to conduct experiments on living animals, where such are necessary to the elucidation of the problems of health, disease, and therapeutics. . . . The only way of successfully contending against the agitation now on foot is to diffuse a knowledge of the truth."—Editor of *Lancet*, p. 343, August 20, 1881.

"The Act apparently contemplates, as the chief subjects of its operation, an imaginary class of unqualified persons, who, with no legitimate relation to scientific research, would under pretence of such research torture, and it is supposed take pleasure in torturing, living animals; and against this devilish class of persons the Act is very indulgently framed; for instead of expressly refusing to license unqualified persons, and perhaps hinting to such of them as would do wilful cruelty, under pretence of study, that the cart and treadmill are for such scoundrels; instead of this, I say, the Act virtually confounds together this imaginary class of unqualified and cruel persons, and, on the other hand, our professional class of *bona fide* scientific workers, . . . What is counted good for one class is counted good for the other."—Simon, Address International Medical Congress, 1881; *Lancet*, p. 323, August 20, 1881.

To the Editor of the Journal of Science.

Sir,—I have placed two paragraphs at the head of this letter. My remarks on vivisection—or, as in my lecture I called it, animal experimentation—must be read by the light of these extracts.

I regret that you have not read my lecture *in extenso;* an abstract does not convey sufficiently clearly what I said. I shall have pleasure in sending you MSS., from which you will see that I lead up to the subject of animal experimentation by illustrations of what commerce, science, life, health had gained by the labours of the men who conducted experiments on living animals.

I am glad you give me credit for good intentions.

I did imagine that I was carrying out the programme sketched in the "Lancet," and that I would best advance the interests of the side I was taking by mild temperate language, so that any ardent "anti-vivisectionists" in the room might see that I did not depend on abuse, vituperation, or calling names, to support my cause.

This was the second occasion on which I spoke publicly in favour of the claims of physiologists—non-medical—to conduct experiments on living animals without the needless and harassing restrictions which are now imposed on them. On both occasions my audience listened to me with attention; on both occasions my views seemed to meet with favour. This concurrence was due to the fact that I did not call my opponents "fanatics," "fools," or hurl other unpleasant epithets at them. Because the parties opposed to scientific advancement heap abuse on such men as Michael Foster, Balfour, &c., it does not follow that we should imitate their bad example, or retort by the free use of strong language.

I need not offer any further excuse for my views. We differ as to our method of warfare. You may be right. I, however, venture to think that my method is more likely to make converts to the cause we both have at heart. As a soft word turns away wrath, so temperate language may have an effect upon those who are now prejudiced against skilled animal experimentation. Is there disunion in the camp? Do we ask for total repeal of the Vivisection Act? Do we demand free vivisection for all?

The "Lancet" may be taken as a fair representative of medical views; perhaps I might even say it represents the opinions of a large camp—the physiologists, biologists, chemists who have done so much for medicine.

The views of the "Lancet" I have adopted, so that if I have compromised the movement your indignation must be vented not only on me, but on the leading journal of medical opinion.

I do not imagine that you can seriously ask for free power of animal experimentation for all, the competent and the incompetent, the novice and the master,—that in the name of Science you consider such unlicensed and unfettered experimentation necessary or advisable. If you do then certainly there is disunion in the camp; but in which camp? You are striking out a line of your own, into which I cannot follow you. I am not considering this question from a purely medical, selfish point of view. I am willing and anxious that all biologists—scientists, if I may use the word—should have the power of carrying on experiments, likely to prove useful to science and mankind, without the restrictions now imposed on them. Competency or fitness for scientific research should be a *sine qua non* with all who engage in such experiments. Who is to vouch for this? There cannot be much difficulty on this point, with the number of learned societies we have. All the young workers soon get known to the leaders in Science in all its departments.

I do not see much humiliation in the certificate, provided it covers the conditions I ask for, viz., that the licensed experimenter may carry on any or all experiments he may think necessary, without the present harassing restrictions. The certificate will be a guarantee that the worker has a definite object in view, and that he understands the manner and methods of research.

You object to my expressions about "torturing a living animal under pretence of research." If you read Simon's Address you will see he alludes to the class (imaginary or not) who, with no relation to scientific research, carry on animal experiments. If there are such a class, then I say let the Act stand in force against them. I asked my audience to discriminate between the qualified and unqualified, and pointed out the injustice of applying the Act equally to both. I have nothing to retract on this point. I do not consider it any hardship to limit experimentation to the class of scientific workers who are anxious to undertake this kind of work—chemist, physicist, surgeon, or physician. In my lecture I clearly point out what I desired for them. Pasteur would not suffer from my conditions if he lived in England.

In grasping at the impossible you may lose the possible. In the present temper of English society I feel that a repeal of the Vivisection Act *in toto*, in favour of free and open vivisection, is an impossibility.

The "Lancet" programme is within the range of practical politics. The disunion in the camp need not any longer continue if you will substitute it for your own, and use your powerful pen in advocacy thereof.

Medical men, biologists, naturalists will derive equal benefit from the Act if it is administered in the spirit and manner I suggest, so that there need be no division of interest.

I regret that my method of educating the public has met with your disapproval. I have the satisfaction of knowing that our scientific men here, outside my own profession, approve of the manner in which I treated this subject.

I distributed 250 copies of Professor Humphrey's Address to my audience, so that if I did any harm his able *exposé* will have neutralised it.—I am, &c.,

T. M. Dolan.

Horton House, Halifax, January 4, 1882.

HYLO-PHENOMENALISM THE SUMMA SCIENTIÆ.

"Cœlum ipsum petimus Scientia."

To the Editor of the Journal of Science.

SIR,—May I venture to claim, in the interest of Science and Philosophy, a small space in your Journal for a few brief remarks in further elucidation and development of some recent contributions to your pages by C. N., under the title of Hylozoism, or Materialism, as opposed to Animism? Without further preamble let me state that the Hylozoic theorem of Life and the World may be formulated as the utter self-evident impossibility—in the nature of things—to transcend or escape in any way from the limits of our own anatomy,—of our own conscious Ego,—the Non-Ego, or falsely so-called "external Universe," being but the objective, or projective, image of our own Egoity, not the *vera effigies*, or absolute substance, of any "thing" external to Self. In other words, that all "things" or entities, or non-entities,—abstract or concrete,—from Divinity downwards, are merely ideal or phenomenal imagery of our own Mind—the essential physical basis, proplasm, or officina of which is the vesiculo-neurine or grey tissue of the encephalic hemispherical ganglia: that, in still more concise terms, Being is Perception and Conception (Ideation), which apparently two abstractions are virtually one,—the function, namely, of a somatic organism,—itself "*fons etorigo*" of all Cognition. On this view of Nature and Mind I trust your enlightened readers will be enabled to realise without difficulty, and as a *self-evident* fact and principle, my corollary, that the only "Spirit" or "Anima Mundi" accessible to us is the animal life on the earth, and, in the last analysis, our own consciousness, by which alone we feel "we live, move, and have our being," or, in less mystic phraseology, are cognizant of motion and sensation. So that no objection can be valid against Hylo-idealism, on the score of any contradiction between Determinism or Necessity, and Self-Determinism or Free Will; the seemingly two being really—*i.e.*, ideally, or phenomenally, or relatively—identical; the Absolute being to Man an inaccessible *Terra Incognita*. Let me illustrate the reconciliation still further by quoting a fallacy embodied in a couplet of Pope's "Universal Prayer":—

> "And binding Nature fast in Fate,
> Left free the human Will."

Surely it is clear and *self-evident*, on this theorem of Hylo-Idealism,—the sole legitimate creed, as I contend, of modern

Physics and Physiology,—that though Fate or Natural Law presents itself to our conscious Ego, in the domain of Cosmical Science, "as if" rigidly immutable and inexorable, yet as this Law, which includes Gravitation or the self-activity of Matter, is one with the law of our own organisation,—is, indeed, as Mr. Ward ably shows in your January issue, a purely mental abstraction, not an *absolute* force in "Nature, as vulgar Realism conceives it,*—and thus only a fiction, or imaginary or esoteric enactment of our own brain, the whole question of Free Will and Necessity resolves itself into a Skiamachy, or dance of shadows. I find this view a perfect Eirenicon on the momentous question of free will and human responsibility to any Power other than Self. "We *must* must," but the compulsion is none, since it is a law of *our own* nature, and is thus transformed into the law of perfect Liberty. Exact Science has been justly defined by some of its most competent contemporary authorities as "*only*" reasoned out Common Sense. Surely all Speculation which cannot be brought to that test is condemned as anarchic by sound Reason,—acknowledged by the ablest apologist of Animism and Christianity, Bishop Butler, to be the plenipotent judge even of "Divine Revelation" itself. Certainly modern Nosology has identified all "sacred" and "profane" manifestations of Animism, or Spiritology, as it is called by Guiteau, the latest pretender to "Divine Inspiration," with quite ordinary symptoms of disordered cerebration, "familiar as household words" to every clinical tyro, especially in the department of alienistic medicine. I need hardly add that this vital and physical thesis quite excludes all trustworthy knowledge as to any power of an animistic kind "behind" or "above" Nature or Brain, the officina—or, indeed, artifex—of Nature leaving us in the state of quite satisfactory Agnosticism, "*Ne sutor ultra crepidam.*" The very keystone of Hylo-Phenomenalism is the impossibility of affirmation or negation, as regards any "phenomena," outside the subjective universe of Self—our only "Final Cause." The whole universe of things and thought is, indeed, on this view, only an Auto-morphosis,—each Ego being to itself, as Protogoras postulated, the measure and standard of all existing things, of all thought, and of all objects of thought whatsoever, and actual altruism being but a dream. The animistic or spiritual heresy is thus relegated into the limbo of Mysticism, defined in the last (eighth) edition of the "Encyclopedia Brit."

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* Mr. Ward's precise words, in his letter entitled "Professor Ball's Glimpses through the Corridors of Time," are—"The Professor obviously believes that Gravitation is an absolute Force in Nature, and not, as Newton taught, a purely abstract" [*i. e.*, ideal or hylo-phenomenal] "conception of the laws or principles of motion." I may mention that Professor Tyndall takes the same absolutely real view as Mr. Ward imputes to the distinguished Astronomer Royal of Ireland, and rejects the theory of Hylo Phenomenalism, or nineteenth century Nominalism (*see* M. Littre's Dictionnaire), as a quite visionary *schwindel* and wild mental aberration, unworthy of scientific notice.

as "that form of error, whether in Religion or Philosophy, *which mistakes the operation of a merely human faculty*" [or organic function—the Italics are mine] "*for Divine*" [or any other animistic] "*manifestations.*"—I am, &c.,

ROBERT LEWINS, M.D.

Army and Navy Club, January 11, 1882.

GEOLOGICAL RESULTS: SUGGESTIONS.

To the Editor of The Journal of Science.

SIR,—In my letter last month I omitted to state (what may possibly have at once presented itself to many minds) that faults of the kind referred to, instead of being roughly like a Y, are more likely to be X-shaped, or crossed; in which case the explanation would be obvious, viz., first one fault occurred, and then a second definitely afterwards, across the former, indications whereof could be traced by inspection. But is it so? I am inclined to think the Y-shape are the more likely.

In case there was not the continuation at all, at the V base, I should suggest it was the result of an upheaval, where the ground opened fan-like; therefore it is possible such would be found wider at the top of the individual fault itself than at the base, and the wedge might have slipped farther in, thus presenting a peculiar appearance. However, these are but suggestions thrown out for what they are worth.—I am, &c.,

D. Y. C.

Leeds.

NOTES.

Dr. Lund ("Comptes Rendus") has discovered fossil human skulls in the caverns of Lagoa Santa. He considers that in America, as well as in Europe, man existed along with various mammals now extinct. The Brazilian skulls are distinguished from those found in Europe by a combination of dolicocephalism and of hypsistenocephalism.

M. E. Bourquelot shows, in a communication to the Academy of Sciences, that the liver and the pancreas of the Cephalopods produce, or at least contain, a ferment which has no action upon crude starch, but which transforms hydrated starch into sugar.

M. Jobert ("Comptes Rendus") has brought to light a remarkable instance of parthenogenesis in *Eumolpus vitæ*, a Chrysomelid beetle very destructive to the vine. The author has dissected 3728 specimens without finding a single male. The "samen kapsel" of the females never contains spermatozoids, yet the eggs are always fertile.

Mr. E. A. Axon ("Comptes Rendus") gives cases of deaf-mutes who on being taught to articulate were found to have the peculiar accent of their native district, which they had never heard. Some naturalist would call this "instinct!"

M. Brown-Sequard, in a communication to the Academy of Sciences, concludes that a number of parts of the nervous system may act suddenly, or very rapidly, in a purely dynamic manner, and without the intervention of nutrition upon other parts of this system, so as to increase the power of action of the latter.

The conclusions drawn from the recent French dredging expedition in the Mediterranean are that this sea cannot be considered as forming a distinct geological province, but that it has been peopled by immigration from the ocean.

MM. Grasset and Amblard ("Comptes Rendus") maintain, as the result of recent experiments, that morphine is not diametrically opposed to thebaine, but has to a certain degree the characteristic property of the latter. The excitometer effects of opium must not be exclusively ascribed to the "convulsivant" alkaloids, but in part to those which are considered soporific. The action of morphia upon Mammalia is not opposed to its action upon the frog.

According to M. F. Jean the tannin of wines, derived from the seeds and the stalks of the grape, gives a greenish black colouration with ferric chloride. Any other colour indicates the presence of an astringent body foreign to wine.

M. Tacchini (" Comptes Rendus ") concludes, from spectroscopic observations, that hydrocarbons are always present in comets.

Acanthephyra purpurea, found at the depth of 2590 metres near the Berlinguer, is of a splendid carmine-red colour.

M. Faye (" Comptes Rendus ") combats the notion that a series of circumpolar stations would be of importance for meteorological observations.

N. Pringsheim, in a memoir communicated to the Berlin Academy of Sciences, discusses the primary actions of light upon vegetation. These actions, he concludes, consist in thermic and photo-chemical effects, the influence of which can be directly recognised in the several constituents of the illuminated cell.

We are happy to learn that the Harveian Society have passed a unanimous vote of congratulation to Prof. Ferrier on " the happy result of the fanatical prosecution to which he has been subjected.

According to M. Davaine (" Comptes Rendus ") the speed with which the virus of glanders is absorbed, when introduced under the skin, varies greatly.

M. Fano, in a communication to the Academy of Sciences, shows that the choroid membrane of the eye has a more important function than that commonly ascribed to it, and has a decided influence on the distinctness of vision.

J. D. Caton (" American Naturalist ") gives some interesting particulars on the changes in domesticated animals if allowed to run wild.

M. C. de Merejowski (" Comptes Rendus ") gives an account of a red colouring-matter (tetronerythrine) present among various groups of Cœlenterata, Echinodermata, Crustacea, Mollusca, and fishes. He considers that, like hæmoglobine, it subserves respiration, in this case cutaneous.

Rev. L. J. Templin (" Kansas Review of Science ") describes the large wasp *Pepsis formosa*, known as the Tarantula (*Mygale Hentzii*) killer. It hunts for its prey by scent, paralyses it by a sting, and carries off the body as provision for its nest. It refuses a Tarantula which has been killed.

W. H. Dale (" American Naturalist ") describes a tame snail—species not named—which would come if called by a little girl who used to feed it, but withdraw into its shell if anyone else spoke.

J. E. Todd ("American Naturalist") reports an instance of an *Asilus*, about three-fourths of an inch in length, which had succeeded in capturing a dragonfly, and was sucking its juices.

M. E. Blanchard ("Comptes Rendus") argues, from the general identity of the flora and fauna of the African, European, and Asiatic coasts of the Mediterranean, that this sea is of recent origin. To this it is replied, that the similarity of organic forms is explained by the former existence of a neck of land connecting Spain and Africa, and another stretching from Sicily to Tunis.

According to M. Rolland the Artesian wells in the oasis of Constantine contain several species of mollusks, crabs, and fishes found in the surface waters of the region.

We extract the following passage from "Light" (December 31, 1881). Col. Olcott one afternoon visited Forest Hills Cemetery, and on the spur of the moment devised the following test:—"Passing through the greenhouses my attention was struck by a curious plant, with long narrow leaves striped with white and pale green. It was the *Dracœna Regina*. With my blue pencil I marked on one of the leaves the cabalistic sign of the interlaced triangles, and requested the Spirits to bring it to me at the circle the following evening. I purposely sat at Mrs. Thayer's right hand, and held her hands, when suddenly I felt something cool and moist drop upon my hand, and when the candle was lit *found it to be my marked leaf. I went to the greenhouse, and found that the leaf selected by me had actually been broken off.*" I need make no apology for preserving testimony of this nature to the facts of mediumship so remarkable as Mrs. Thayer's. Col. Olcott afterwards put her in a bag, and otherwise rendered her helpless in her normal state, but still flowers, peaches, and birds were produced. One point further is worth notice. These flowers were of natural growth. Whence did they come? In a few cases from neighbouring gardens; in most, from an unascertained source. By what means were they severed? Colonel Olcott examined the stalks. "They had been broken off—not short off, but with a thin ribbon of bark at one side; and around the fracture, in almost every case, was a little ring of black, as though an electrical current had effected some chemical change in the chlorophyll." This may be significant.

The age of the Mediterranean has latterly become a subject of discussion among French geologists.

M. P. Cazeneuve ("Comptes Rendus") has examined the secretion of uric acid in birds. He concludes that in different species the decomposition of the albumenoids is effected according to special equations. This decomposition being probably connected with the phenomena of hydration, rather than of oxidation, the ingestion or the privation of oxygen makes little difference.

Prof. Elsberg ("Science") proposes the term "plastid" in place of "cell."

M. Grand' Eury, in a communication to the Academy of Sciences, maintains that during the Palæozoic epoch the Ural Mountains separated two seas.

H. Sprung ("Naturforscher") considers that there may be traced a daily periodicity in the direction and in the force of the wind.

M. Carl Vogt ("Comptes Rendus") has examined the alleged meteoric organisms of M. Hahn, and finds that they are produced merely by crystalline conformations, purely inorganic.

(This announcement will for the present extinguish much speculation as to the dawn of life upon our globe. The "moss-covered fragment" must again be banished to the realms of conjecture.)

M. V. Lémoine ("Comptes Rendus") describes the *Gastornis*, a gigantic fossil bird with wings unfit for flight, but which may possibly have served for swimming. This bird has some analogies with the Cursores and the Palmipedes, but forms, upon the whole, a type distinct from all known at present, and is in many respects reptilian.

M. Laulanié ("Comptes Rendus") shows that the specific agent of tuberculosis acts in the same manner as the ova of *Strongylus vasorum.*

According to M. Paul Bert ("Journal de Therapeutique") special venoms are secreted by the toad, salamander, newt, frog, &c. From the glands on the neck of the frog he has collected a liquid which if injected into a sparrow occasions death with convulsions, the heart being arrested in systole.

M. W. G. Levison, of Brooklyn, has examined the spectrum of the light of the firefly (? species). He finds that the blue and violet rays are absent, and that the less refrangible rays predominate.

MM. A. Dumontpallier and P. Magnin ("Comptes Rendus") consider that there exists in the dorso-lumbar region of the spinal marrow an inter-crossing of the sentient and motor fibres, which accounts for the simultaneous movement of an anterior member of the one side and a posterior member of the other.

(These movements, however, are not strictly simultaneous.)

We learn with delight that an anti-vivisectionist who subscribes £20 yearly towards carrying on the anti-scientific agitation has been fined for maltreating an "unoffending" animal in his possession. How much a revised and enlarged edition of the "Devil's Walk on Earth" is needed!

M. Schützenberger, in experimenting upon the petroleums of the Caucasus, has observed facts which seem to show that the atomic weight of the elements are not absolutely fixed, but may vary within certain narrow limits. Petroleum, aniline, and benzol, if distilled in contact with sodium and kept in the dark, give on analysis 101 to 101·5 per cent of carbon and hydrogen; but if exposed to the light for two hours the yield is only 100 per cent.

The "Magdeborgische Zeitung" has established a meteorological observatory, well equipped and placed in competent hands. The object is the benefit of agriculture.

According to "Ciel et Terre" two new small planets have been discovered during the past year, raising the total number of the group of worlds between the orbits of Mars and Jupiter to 220.

M. Dufour, in a paper read before the Helvetic Society of Natural Sciences, points out that in calm weather the images of distant objects, reflected in the Lake of Geneva, appear distorted exactly as calculation shows they ought to be in consequence of the figure of the earth. This is a new and excellent proof that the earth is round.

The "Pall Mall Gazette," criticising Shairp's "Lectures on Poetry, writes:—"Chamæleon's food is light and air; the molar teeth of a man indicate more substantial diet; we need even silicious particles to form the bones." Chamæleons are in these days found to feed upon insects, and the mineral part of our bones, on analysis, proves to be formed not of "silicious particles," but of salts of lime and magnesia.

The new Science College at Birmingham has already stultified itself. The governing body have refused to allow Dr. Haycraft, their Professor of Physiology, to apply for a license under the Experiments on Animals Act.

It is rumoured that the Natural History Professorship at the University of Edinburgh has been offered to Dr. F. M. Balfour.

Dr. Conrad Keller, Professor of Zoology at Zürich, is engaged in a scientific exploration of the coasts of the Red Sea.

According to the "Gazzetta Chimica" potassium ferricyanide (the red prussiate of potash) cannot be used for distinguishing the ptomaines from vegetable bases, since, contrary to the assertion of MM. Brouerdel and Boutmy, it is reduced by both.

Original Researches.—The Royal Society of New South Wales offers a Prize for the best communication, containing the results of original research or observation, upon each of the following subjects:—

Series I.—To be sent in not later than September 30th, 1882,

No. 1. On the Aborigines of New South Wales, £25.
2. On the treatment of auriferous pyrites, £25.
3. On the forage plants indigenous to New South Wales, £25.
4. On the influence of the Australian climates and pastures upon the growth of wool, £25.

Series II.—To be sent in not later than August 31st, 1883.

No. 5. On the chemistry of the Australian gums and resins, £25.
6. On water supply in the *interior* of New South Wales, £25.
7. On the embryology and development of the marsupials, £25.
8. On the Infusoria peculiar to Australia, £25.

The competition is in no way confined to Members of the Society, nor to residents in Australia, but is open to all without any restriction whatever, excepting that a prize will not be awarded to a Member of the Council for the time being; neither will an award be made for a mere compilation, however meritorious in its way—the communication to be successful must be either wholly or in part the result of original observation or research on the part of the contributor. The successful papers will be published in the Society's annual volume. Fifty reprint copies will be furnished to the author free of expense. It is the intention of the Society to offer additional prizes should this first attempt to encourage original scientific investigation be reasonably successful.—A. LIVERSIDGE, A. LEIBIUS, Hon. Secs.—The Society's House, 37, Elizabeth Street, Sydney, November 2, 1881.

We extract from "Light" the following theoretical view of the interior of the globe:—"Here, at what we call the centre of the earth, I see a small globe enveloped with a crust or shell; the space within the said shell I designate No. 1 Space, and its crust I call No. 1 Crust, the whole of which forms a small globe which I name the Primal Globe. This globe may, with due propriety, be termed the heart of the earth. It seems to revolve on its own axis with great velocity, much quicker than the superincumbent spheres. Within this Primal Globe is the grand source or fountain of all life upon this planet. Within this Primal Globe exists a light surpassing the light of the sun in brilliancy. This light existed, it might be, for millions of ages prior to the crust; it then revolved in space like some bright star, and, as it at the first was not so much condensed as now, it might at some far back period have resembled a comet. Here, then, I find the one chief factor of all earthly existences. I observe that the north and south points of this inner globe, as well as those of our globe, are not simply flattened, but are slightly concave. This is the result of attraction at these points being so intense,—similar to the end of an apple or orange, which is not flat, but slightly indented."

"Truth" gives a pen-and-ink sketch of Prof. E. Ray Lankester which is at any rate instructive as showing what the modern fast *litterateur* thinks of the modern man of Science. We implicitly believe the writer when he says that he would prefer the society of a "healthy fool" to that of the learned Professor!

Prof. Meehan ("Kansas City Review of Science") decides that the timber line of high mountain-tops results from the washing down of the earth from the higher elevations.

The overthrow of the Gambetta Administration involves a loss to Science in the removal of Dr. Paul Bert from the ministry of Public Instruction.

A daily paper for the 17th ult. speaks of the "sodium of calcium" as a dangerous compound.

"Light" contains a great—and we may say an increasing—array of incidents which demand serious consideration. In many cases the stale explanations of trickery or of "DOMINANT IDEAS" are utterly inexplicable. We do not, however, like the form of Signor Damiani's challenge to Professor Huxley. It is substantially a bet, and betting is, in our opinion, "ultima ratio stultorum."

We learn that the Rev. C. Spurgeon has vouchsafed to express his "loathing" of vivisectionists.

Keller ("Vierteljahrschrift der Natur. Gesellsch. *Zürich*") gives the following proof of the existence of a well-developed colour sense among Mollusca. A sepia (*Eledone*) in the Naples Aquarium was fleeing from the pursuit of a powerful lobster. During its flight it appeared of a pale red colour. Next it placed itself upon a piece of yellow tufa covered with brown spots, and assumed both the yellow ground colour and the size and shade of the spots, with such deceptive accuracy that it could scarcely be recognised by the observer.

The apparatus employed by Prof. Abbe, of Jena ("Journal of Science," vol. iii. p. 375, 1881), for demonstrating the influence of diffraction spectra in the formation of the microscopic image, is now made by Herr Zeiss, and can be obtained through his agents. Although great pains have been taken, at the Royal Microscopical Society and elsewhere, to make known the peculiar conditions under which the microscopic image is formed, very few persons have paid much attention to the subject. Like most old-established opinions, the dioptric theory of the microscopic image still holds its ground. It only needs the experiments to be seen to be convinced of the important bearings of Prof. Abbe's discovery. A few hours spent in observing the wonderful influence the diffraction spectra have upon the magnified image will do more towards banishing the old erroneous ideas than the mere reading of many elaborate optical papers. No one can read the abstracts of Mr. Stephenson, Mr. Crisp, or the few pages devoted to the subject in the last edition of Carpenter on the Microscope, and at the same time carefully work through the simple experiments there described, without greatly adding to his knowledge of what seems at first a hopelessly obscure subject. For the purpose of examining the diffraction spectra in a more effectual manner than the usual way of removing the eye-piece and looking down the tube of the microscope, Mr. J. E. Ingpen, Secretary of the Quekett Microscopical Club, places a small "*Ramsden*" eye-piece, suitably mounted, over the ordinary eye-piece: by this means the ocular is converted into a small telescope, and permits the condition of the diffraction spectra which are formed just above the back lens of the objective to be readily observed.

At the January meeting of the Royal Microscopical Society Mr. J. W. Stephenson gave the manipulative details of his process of mounting diatoms in phosphorus ("Journal of Science," vol. iii., Third Series, 1880, p. 733). He also gave an account of another effective medium for mounting objects to be examined with homogeneous immersion objectives. The new fluid consists of a saturated solution of biniodide of mercury in a saturated solution of iodide of potassium. The refractive index is 1·68, giving a difference of visibility over balsam, in the case of diatomaceous silex of 0·14, and of air 0·54. The object is mounted by spinning a circle of white wax on a hot slide. This cell is filled with the medium, and the diatoms attached to the cover placed upon it; a heated metal ring—*e.g.*, an old gun-punch—is then pressed down in the cover to squeeze out the surplus fluid and melt the wax round the cover. After washing, to remove all traces of the solution, a few coats of gold-size will permanently secure the preparation. This medium possesses the advantage of being reduced to any refractive index needed by dilution with water, and from its antiseptic properties would seem capable of preserving animal and vegetable tissues well; of course time only can decide its properties in this respect.

M. A. Colson ("Comptes Rendus") remarks that if disks of iron already partially carburetted are heated along with fresh disks, both absorb the same quantity of carbon if the diffusion of carbon in the metal is proportional to the duration of the heating. To a given temperature there corresponds a constant coefficient of diffusion of carbon in iron. This law is only true when the iron is converted into steel. When cast-iron begins to be formed—that is a little before the iron becomes brittle—the absorption of carbon decreases. Silica ranks among the bodies most easily diffusible in carbon. By heating platinum in lamp-black containing 60 per cent of precipitated silica, we obtain a crystalline body, Si_2Pt_3, of the specific gravity 14·1, and melting at about the same temperature as common glass.

MM. Berthelot and Vieille, in a paper on the Speed of Propagation of Explosive Phenomena in Gases ("Comptes Rendus"), observe that the general mean speed of propagation in a tube, whether curved or straight, 0·005 metre in diameter, is 2810 metres per second. The material of the tube is indifferent. The speed is sensibly the same whether the tube is open or closed. The differences observed in tubes of different lengths fall within the limits of error. Under the circumstances of the author's experiments the speed of propagation of detonation—either with a mixture of oxygen and hydrogen, or of oxygen and carbon oxide—is independent of the degree of pressure. The introduction of an inert gas retards the detonation.

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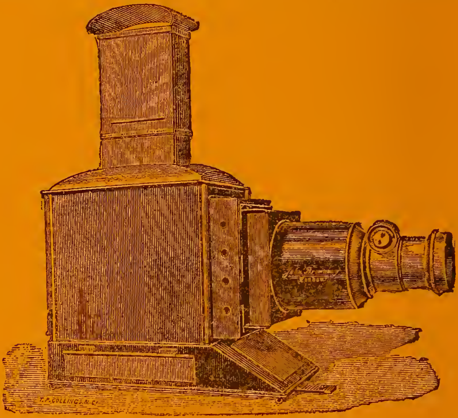

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THE

JOURNAL OF SCIENCE.

MARCH, 1882.

I. THOUGHTS ON CHEMICAL AFFINITY.

By CHARLES MORRIS.

IN my paper on the Principles of Magnetism, published in the "Journal of Science" for January and February, 1882, certain theoretical views were advanced which seem susceptible of a wider application than was there given them. In the present paper I propose to apply them to the phenomena of Chemical Affinity.

The whole science of Chemistry consists in the investigation of the attributes and combining properties of the molecules of matter. It begins with an investigation of the differences and relationships of the bases of the several elements—the so-called chemical atoms. It follows with a like investigation of the various compounds of these elements, and of the peculiarities of attraction which they display. Their physical properties, their electrical behaviour, &c., are included in the above summary.

But when we come to ask, What are the properties of elementary and compound substances? we are apt to receive a much too diffuse answer. Their colours, tastes, shapes, and their physical effects upon the human system, are given as distinguishing properties. These characteristics are, of course, important as aids to the recognition of substances, yet they express only their physiological effects; their action upon light, and through it upon our senses; or the results of their direct contact with the body.

But if we consider only the immediate relations of the elements with each other, these external characteristics, which apply to them principally as masses, disappear.

There remain only their affinities, their specific gravities, and their thermal and electrical relations. It is to their affinities we wish here to particularly refer. The minute particles of elementary matter attract each other with a vigour which differs with every change of substance, being powerful in some cases, and weak or non-existent in others. And this attraction is more powerful between elementary atoms than between compound molecules. If Chemistry be rigidly separated from other sciences, the above phrases almost completely embrace it.

But what are the true characteristics of the attractions which thus tend to combine chemical atoms and molecules into more complex molecules? Or we might first ask, What are the characteristics of attraction? It has, as we know, one general form, that of gravitation, which affects all matter alike, without discrimination. It has, also, one special form, that of magnetism, which affects all compounds of matter, but which specially discriminates. In its general form of gravitation I have argued in a preceding paper that the attractions of matter are balanced by their repulsions, but that the attractive matter has everywhere gathered into globes and systems, so that repulsive vigour, in its general aspects, now only exists between widely separated masses of matter. In its special form of magnetism the attractions are visibly balanced by the repulsions, these conditions occurring together in every mass of matter. Beyond these two modes of attraction there is no positive evidence that any other exists; for electric attraction may possibly be a special display of magnetic energy, while physical cohesion and adhesion resemble gravity in their characteristics. There remains but chemical attraction, and we may reasonably ask Is this a special mode of attraction, or is it a manifestation of gravitative or of magnetic energy? It cannot be a result of gravity, since it discriminates in its action. It therefore must be magnetic, or else a special mode of attraction.

As to which of these explanations should be adopted we have a useful rule of guidance. If it were impossible to explain chemism by any known mode of energy, then there would be some warrant for ascribing it to our unknown mode. But if it can be shown to be explainable by a known mode, this obviates the necessity of seeking any unknown mode; since it is undeniable that whatever tends to simplify and reduce the seeming complexity of natural principles is in the true path of correct discovery. Let us try, then, if we can apply the laws of magnetic energy to the phenomena of chemical affinity.

The ordinary display of magnetism is an influence emanating from molecules which are separated by considerable intervals, and whose magnetic effect upon each other is, therefore, much decreased. But in chemical action the spaces separating the molecules are greatly reduced. The heat energy which kept them asunder is yielded outwardly, and they come into intimate union. They are then in a position to develop each other's magnetism. In the former case they resembled two magnets so far separated as only slightly to affect each other. In the latter case they resemble two magnets which are made to touch each other.

But magnets may touch in different modes, and thus produce various combinations. If brought together end to end, they attract if their adjacent poles are unlike, and thus compose a single long magnet. There is no doubling of energy in this double magnet. It attracts no more strongly than did each of its constituents. If the magnets are brought together side by side, with unlike poles in conjunction, they will also attract, but the magnetism of each will mask that of the other, and thus there will be no external display of magnetic energy. If brought together, in either of the above positions, with like poles adjacent, they will mutually repel.

If, instead of two, three or more magnets be employed, their possible modes of combination will increase in variety. The effective energy of a strong magnet may be decreased by astatic union with weaker magnets. Also the poles of a strong magnet might attract several weaker magnets, whose free poles, being of the same name, would mutually repel.

If, now, chemical affinity really arise from the attractive relations of molecular magnets, brought very close together, it should display peculiarities like those seen in the combinations of mass magnets. But it might also display characteristics not usually seen in the mutual action of mass magnets. The facility of rotation of the molecules would tend to make them usually assume the strongest magnetic relation, that of astatic union: they might, if in considerable number, unite in all the various modes in which a collection of magnets would come together, but when only two molecules were concerned their combination would most probably be astatic.

This idea is very significant if we apply it to one of the primary chemical actions. It is now generally believed that the chemical atoms never, or only in exceptional cases, exist singly, but that they are ordinarily combined in pairs. And it is also found that when single, as when just released from combination with some other element, their chemical vigour is far stronger than after they have had time to combine among themselves, and form atomic pairs. Such a result would necessarily follow if their attractions were magnetic. In the free, or nascent, state their magnetic attraction must be far more vigorous than after they have formed astatic pairs with each other, and thus have become magnetically inert. In a case like that of ozone, where three chemical atoms of equal strength are conjoined, we would have a weak magnetic system, since each magnet must disturb the attraction of the other two. One of these oxygen atoms might thus readily yield to outer attractions, and the two remaining enter into a more vigorous union. But four atoms, as in the molecules of phosphorus and arsenic, might naturally conjoin in a square or circle, each being astatic to its two neighbours. Any even number of atoms must produce a more vigorous astatic arrangement than an odd number.

Another peculiar feature of chemical affinity, that of the possession of varied bonds of affinity by varied elements, may perhaps be equally explicable on the magnetic hypothesis. It might be that the monad has only one-half the magnetic energy of the dyad, one-third that of the triad, and so on ; and that, therefore, it would require two monads to satisfy the magnetic energy of one dyad, &c. This could scarcely be were all the chemical elements prime molecules of matter. The magnetic energy of these could scarcely possess such exact numerical relations. But if the chemical elements be really, in great part, more or less complex compounds of these prime molecules,—if there be but one, or but few, kinds of prime molecules, from whose simpler combinations the chemical elements arise,—then the free energies of the latter would necessarily be in strict numerical proportion. They would comprise sums of equal magnetic units, some of these being masked by their astatic combination, others directed outwardly, and the element would display as many bonds of attraction as it had units of magnetic energy directed outwardly.

There is another chemical condition to which we must here refer. This is, that the quantivalence of an element is not at all times the same, and that, when it varies, it loses or gains two, or a multiple of two, bonds, never—with a few possible exceptions—one or three bonds. This fact is explained in ordinary chemical language by saying that the free bonds satisfy each other, and that, therefore, they must be in even numbers. But there is no explanation as to how they satisfy each other.

This mystery ceases to be one under our magnetic hypothesis. The free bonds are simply free magnetic poles, and they may be satisfied by magnetic reversal and astatic union in any two of the polar molecules. If, for instance, the five bonds of an acting molecule consist each of a magnetic unit, then one, two, three, four, or the whole of these, may attract monad atoms. But if four bonds be thus employed, the fifth cannot become masked; it can only satisfy its attractions outwardly. If three only be employed, the remaining two may satisfy each other's attractions. Inductive action between them may cause a reversal of poles in one or the other, and they thus become astatically combined. The case is similar to that which is known to occur when a number of magnetic needles are bound together to form a compound magnet. The poles of some of them become reversed by induction. Every one so reversed must mask the magnetism of one not reversed. Thus the bonds of attraction of the compound magnet are reduced by twos with every reversal. If the magnetism of half the needles were reversed the compound magnet would become inert. Each of its poles would have an equal north and south polar energy.

But if, in any such case, a vigorous magnetic energy be brought to bear upon the compound from without, it is not impossible that it might overpower this local influence, and reproduce the original arrangement of the poles. Thus, in the molecule of five bonds, the two masked ones might assume their former conditions, and again display outward attraction.

The graphic formulæ now given in works on chemistry plainly show the application of this magnetic hypothesis to chemical compounds. If, in a complex organic compound, we consider each C, O, H, N, &c., of its formula, as written out graphically, to be a magnet, with a definite attractive vigour of one, two, three, or more units, and that part of these bonds are attached by attraction to equal bonds of other elements, while part satisfy themselves by astatic combination, the formula seems to assume a new phase, and much of the mystery which has enveloped it to yield to the test of this new way of regarding it.

Of course the hypothesis, as so far outlined, does not explain the mysteries of elective affinity. We might reasonably assume that combinations of magnets could be, in no sense, elective in their attractions, and that every two molecules, of whatever character, possessed of free magnetic energy, would tend to combine. Of course, in the great variety of modes in which magnets might possibly combine, there might be considerable differences in attractive vigour, the magnetic energy of some being employed inwardly, and that of others largely directed outwardly. There might also be great differences in responsiveness to induction, through the different degrees of centripetal magnetic energy. But aside from the phenomena of chemical inertness or activity arising from these causes, there are peculiarities of affinity which need some other explanation.

Elective affinity has some close connection with the electrical behaviour of the elements. As a rule, the most vigorous affinities exist between elements farthest apart in the electrical series, while compounds of these elements display affinities which diminish in vigour as they approach the neutral region between the electrical extremes. It remains true, however, that there are many instances of special affinity which have no definite relation to electrical behaviour.

In static electric attraction and repulsion, it is very possible that the electric condition affects the magnetism of molecules. That electric excitement is an affection of molecules is undoubted, and that it produces heterogeneous conditions in each molecule, yielding the phenomena of electric polarity, is equally evident. If, then, the two halves, or the opposite extremities, of the molecule are put into diverse states of energy by the inductive action of electricity, it is very possible that their magnetic condition may be affected by the same cause. The electric excitement seems to weaken the chemical cohesion of the constituents of molecules, and to cause them to exert a more vigorous outward attraction. But if this chemical cohesion be an effect of magnetic energy, then we might say that the centripetal magnetic energy of a molecule is decreased by electrical excitement, and its centrifugal magnetic energy increased. The electrical induction is an effect of exterior forces, and these may also produce a magnetic induction, weakening the astatic self-satisfaction of molecules, and causing them to seek exterior satisfaction of their energies.

Certainly it is far more likely that the attractions and repulsions of electrised bodies spring from the magnetism which we know to exist in these bodies than that they arise from some unknown attractive condition of matter. That the intimate action of electricity upon molecules might produce effects upon their magnetism, far superior to anything which human experiments with magnets can perform, is very evident; and it is not at all surprising that substances inert to ordinary magnetic influence should display exterior magnetic energy, when their most interior energies are separated, accumulated at the molecular poles, and their forces directed outwardly.

The character of the attractions and repulsions of electricity is also closely accordant with that of magnetism. Electricities of the same name always repel, while those of opposite name always attract. But we might otherwise express this by saying that electricity converts the molecule into an active magnet, with its one pole always turned to the positive, its other pole to the negative extremity. Suppose, for illustration, that north magnetic polarity were always associated with positive, and south with negative electricity. Then the peculiarities of attraction and repulsion perceived would necessarily arise. A mass affected with induced electricity would resemble a magnet, with its north pole turned to the positive, its south to the negative end. A mass with positive electric charge would form a collection of molecular magnets, each with its north pole directed outwardly, its south inwardly. The magnetic inharmony thus produced would be the result of the electrical inharmony. Nor need this induced magnetism produce stronger relations with the magnetic needle than with other conductive matter. The mass with induced electricity displays the true magnetic attributes, but only towards electrically disturbed substances. The normal magnetism of the needle has no electrifying influence, and conversely is not affected by the results of electric influence.

There is another feature of elective affinity which needs consideration—a certain arbitrariness which must arise from some special cause. And this arbitrary character of chemical attraction may be due to the cause to which we formerly attributed the electrical excitement, namely, to the diversity in the vibratory pitch of molecules. It is exceedingly probable that these divergencies in pitch of vibration hinder the tendencies of molecules to combine, and that no stable combination can be produced unless these discords are overcome, and are modified into harmonies. Two molecules vibrating at closely accordant rates might readily conjoin. Two less accordant in their vibrations must oppose a certain resistance to conjunction. Two completely discordant might utterly refuse to join, they being unable to form a stable combination.

That such variations in vibratory pitch must exist is unquestionable. And that two atoms or molecules vibrating at discordant periods—in which they might persist to some extent, despite their mutual influence—could not form a stable combination, is equally unquestionable. Although in all such cases magnetic affinity might seek to produce combination, without regard to the special characters of the molecules, this general tendency to combine would be opposed by the special resistance to combination offered by these diverse movements. Two molecules swinging together in unison would support and sustain each other's attractions. Two which constantly darted apart from each other could never form a close union, and would be constantly exposed to exterior energies.

It needs special conditions of isolation from disturbing influences to bring elements of feeble affinity into combination with each other. Such conditions are produced in organic nature, and thus complex molecules are built up whose constituents must display considerable diversities of vibratory pitch. The more intricate these compounds the less coherent are they. Their combinations are only safe while protected from external influences of a stronger character. When exposed, for instance, to oxygen, this element of vigorous affinity disturbs the incoherent union of diverse elements. The varied vibratory swings of the latter hinder them from coming into close and dense union. A certain space must be necessary for feebly accordant movements to take place in, and these intricate compounds, therefore, form molecules of slight density, verging from the solid, through the colloid, towards the liquid. Oxygen seizes, as circumstances favour it, on one after another of the outward swinging atoms or molecules of these compounds, and forms with them molecules of more harmonious motion and intimate elemental relations, so as in time to quite break down the large, but feebly accordant, compound of vibrating molecules.

II. BEAUTY IN THE EYES OF AN EVOLUTIONIST.

By F. Ram.

(Concluded from page 81.)

BARRY, in one of his Royal Academy Lectures, observes that we should not add to woman's beauty by any increase in the number of her mammalian protuberances. But we may safely assert that, if any increase in the number of these protuberances had led to her raising offspring superior in number or viability to those raised under the present arrangement, men would see beauty in this numerical increase; artists would have bestowed them on the Goddess of Beauty, and mammæ in duplicate only would have been repulsive.

One of the many points in which the taste of other races differs from our own is the fondness for extreme obesity which resides in the minds of some savages. Can it be doubted that *Famine*—which has been the chief factor in the production of the bodies and minds of all living creatures—has also been the originator of this strange taste? For the man who desired a fat wife would have been always more likely to have his babes sustained through a time of straitness than one who was contented with a woman who had laid in a smaller store of nutriment on her own person. In a minor degree this fact is seen amongst ourselves at the present day, the leaner females—in the classes in which there is much choice of wives—being more usually left to become old maids. This fact bears witness to the existence of famines in former days. But such a taste could not be expected to be strong in a race whose ancestors secured a scanty living by means of much activity in hunting. Such people would rather pick out their mates with reference to the agility which they saw displayed at some dance or corroborree, and would look rather for grace, or beauty in movement: on which account their descendants perhaps are pleased at the sight of the agility displayed by ballet-girls.

Some parts of the human body are beautiful chiefly by smallness, of which we may instance the shell of the *ear*. This, it is generally now allowed, is a useless rudimentary excrescence, and its maintenance has probably been a mere waste of material for tens of thousands of generations. As the ear-shell must, as is shown by its existence, have been of use to some far-off ancestors, another reason may have existed for its being subsequently discarded. The powers of an animal's mind depend greatly upon the degree in which it can fix its attention upon one subject at a time. The value of performing monkeys depends very much upon the degree in which this faculty is possessed. And indeed a prolonged fixity of attention upon one point is essential to all great mental results. Hence the fixity of gaze of the genius, as compared with "the eyes of the fool, which run to and fro in the earth." Therefore we may suppose that the distracting effect of a sound-collector might have been injurious to man's advance in intellect.

Bernstein, in his "Five Senses of Man," asserts, with reference to the angle (40°) which would be best adapted to the purpose of collecting sound into the human auditorium, that some persons might object to such an angle "on æsthetic grounds." But it is certain that if such an angle, or any enlargement whatever of the human ear, had been advantageous in the struggle for existence in the past, such an altered structure would have been highly approved "on æsthetic grounds." For, if a maximum ability of collecting sounds had been most advantageous, those who were contented with the appearance of a structure deficient in this way would have had fewer descendants (to carry on their erroneous taste) than those who saw beauty in the greatest spread of cartilage that could be beneficial.

So difficult is it to "find the mind's construction in the face" that little *pro* or *con* my theory can be brought from the expressions of the human countenance. But it may be said that the soft smile which gives an additional charm to a maiden's face, by promising placidity of temper, also promises a man that his infant will not be injured during the period of lactation by the acidity of the mother's mind being conveyed, as is often the case, to the mammalian food.

The sentiment expressed in the French proverb "Il faut souffrir pour être belle," though at first sight apparently adverse to the theory maintained above, in reality supports it. Past suffering may give an additional charm to a beautiful face, because it is evidence of strong vitality, the sufferer being seen to have passed through adversity *without dying under it.* Strong vitality promises many descendants; therefore those who admire any possible visible indication of such trait will have always had a correspondingly good chance of having such æsthetic taste inherited.

I will not dwell, in further detail, upon other special points of beauty which—being correlative to excellences of body or mind—ensured a numerous viable offspring to those whose mating was regulated with reference thereto.

Though confident that the theory must be correct with reference to those beauties which produce the largest amount of emotion in the susceptible bosom of either sex, I am not prepared to say that the rule is universally applicable. Should the size, shape, or colour of any part of the body be of no importance, in such case, and in such case only, we may perhaps approve of the *average* of what we are accustomed to see. And thus we may dislike a very big or a very small nose, though either may perform its assigned office well enough. Again, some taste relating to a matter of no importance, if there be any such, may be regulated by sentiment. Thus, should an oppressed nation be ground down by a powerful foe notable for bushy beards, patriotic hatred might make bushy beards an abomination; and in the oppressed community a bare chin might be etiquette for ages after the oppressor's yoke had been cast off.

It may strike some minds that, if a theory connecting beauty with the environments is correct, there would be a uniformity of taste in any community, and that there ought also to exist something like a general prevalence of the beauty fitted to the locality. To which possible objection I reply that, in a race dwelling for a great number of generations in one environment, nearly all the members of the community would be very beautiful in one another's eyes. And I have no doubt that wild animals, amongst whom Sexual Selection prevails, are much to be envied in this respect. For as Natural and Sexual Selection eliminate the members of the species which are ugly in the eyes of the same, all the survivors are adorned with qualities coinciding as nearly as possible with the prevalent æsthetic taste. At the same time any animal which man has domesticated must be hideous in the eyes (if still agreeable to the nose) of its wild relatives who have inherited likings which do not accord with the changed appearance given by man to the domestic creature for his own purposes.

The inhabitants of any country which, like those of England, have sprung from ancestors of various environments, cannot of course often be gratified by the sight of what they consider ideal beauty. Change of environment, whether it arise from the migration of a people, or from such fluctuations in the surroundings as spring up now-a-days in every civilised nation, is inimical to the gratification of inherited æsthetic taste. Therefore there cannot be any type of beauty generally accepted in a country originally peopled as the British Isles have been, even were there no variety of environment therein.

Supposing the environment, by means of Natural and Sexual Selection, makes the beauty accepted by the inhabitants of the locality, how are we to account for the fact that savage nations practise artificial deformities on its members? Only by assuming that the so-called "deformity" is actually beneficial to the race. It does not follow that because we have not yet found out how a flattened forehead is a gain in the struggle for existence, that therefore it is not so. I venture to say that it cannot be materially injurious, and it is certainly most probable that it is in some obscure way a decided advantage; otherwise the taste for it would be weeded out by those having most pleasure in the sight of it lessening thereby the number of their descendants. In such cases, and indeed wherever Sexual Selection acts, we see Natural Selection choosing, as fittest to survive in the locality, the strains which are the possessors of certain brain-cells containing an æsthetic taste.

Amongst artificial deformities must be included the constriction of the waist by English ladies. This practice, though generally now deprecated, will, I believe, come to be understood in time. Women who do not perform more foot-pounds work than is accomplished in a promenade have a good deal more lung-power than they require, and it is a question whether a reduction of the oxygenation done in the body does not lead to a diminution in the amount of food which the digestive apparatus is called upon to deal with. To talk of "interferences with Nature" is not to the purpose; for, as with all other animals, the organs with which mankind are at birth endowed have no reference whatever to their own future requirements, but are fixed solely by the needs of their forefathers, from whom they inherit them.

But whether a tightened cincture is good or evil, the object in the mind of the lady who thus operates on her own waist is to appear "genteel." This natural inherited instinct—the desire we have to appear to belong to the upper ranks of society—springs from the fact that in former times the higher were the *safer* classes, the lower being more likely to perish from want; on which account the proud and ambitious, who strove to raise their social position, left more children (inheriting their traits of character) than those who were content with their natively humble grade. One aim of the slight waist is therefore parallel to that of wearing fine clothes, or any mimicry of a higher rank, namely, the facilitation of marriage relations with an order having the means to bring up a larger percentage of their progeny. Besides which, the higher classes are more tenacious of life than the lower, because they are sprung from progenitors the length of whose lives enabled them to hoard for their issue that wealth on which alone social position depends. Therefore to marry into a class above one's own is usually equivalent to having children of greater natural vitality—entailing a correspondingly abundant transmission of the ambition to future generations.

The theory of Beauty dealt with in this article relates to the beauty of an animal in the eyes of its own species, and therefore it is unnecessary to dwell here upon that which man sees in brutes, which, if comparable to a human type,—as, for instance, in their optical organs or in their hair,—may be pleasing or otherwise. If not so comparable, they are almost outside æsthetics ; for an elephant, or hedgehog, can hardly by their appearance cause more æsthetic emotion in us than a locomotive or a lump of coal.

Of landscape, and the charms which exterior Nature at large has for us, it may be affirmed that our taste must have been formed with reference to the environment, those best pleased with their surroundings reaping such physical advantage therefrom in health, &c., that they were the most viable and prolific in the locality, and so left more descendants, inheriting their taste. If vegetation had been universally red instead of green, and the sky brown instead of blue, those colours would have been thought most beautiful for earth and sky,—not indeed by us, but by those who, under those altered circumstances, would have been selected to occupy our places. If people now living under clouded skies prefer the blue welkin, it is because their race has inherited a love for the same from forefathers who long dwelt under a cerulean vault. The leaden canopy of England will be charming to those living under it when a sufficient number of generations have passed for Natural Selection to have acted on. The love of mountain scenery which some men possess records the fact that their ancestors were benefitted by such a taste, which led them to dwell in localities least accessible to the foe.

The proper subjects for artistic representation are those which are pleasing to our sight by reason of their relation to the *past* environment of our race. We like to see on canvas simple peasants in homely attire, rather than fashionable people dressed in the latest mode. Delineations of steamships, railway trains, and other appurtenances of civilisation, seem out of place on the walls of an academy.

They do not awake, in persons who are æsthetically emotional, the sentiment which springs from the sight of paintings of queer small ships, or boats with quaint old rigging, old tumble-down cottages, or roughly-built carts. The latter sort of things composed our forefathers' surroundings, and not steamships and locomotives. If the latter had borne them over land and sea for a thousand generations, they too would by this time have afforded to the artist fit subjects for his pencil.

But for the extent to which this article has run, some evidence might be added to show that our love or hatred of such sounds and odours as mankind have come into contact with abundantly, have been acquired by a process analogous to that by which man's taste for visual beauty was bestowed upon him.

I have only to add that, although physical beauty only has been referred to in this article, it is clear to my mind that the mode of the origin of man's principal ideas of *moral* beauty must necessarily be closely analogous to that of his main ideas of the physical.

III. MESMERISM.

By N. Gordon Munro.

Doctor.—"You see her eyes are open."
Gentleman.—"Aye, but their sense is shut."

THERE seems to be in this age of scepticism and doubt a prevailing tendency among men of Science to entertain feelings of contempt towards anything which is, even in the slightest degree, invested with the character of the supernatural. Whatever has a tendency to disturb preconceived opinions, or to pass beyond the limits of our present intelligence, is, without inquiry, condemned as an absurd and dangerous innovation. Now this antagonism and habitual resistance to whatever seems new, instead of being productive of good, is nothing more or less than the outcome of prejudice and self-interest, and as such merely serves to interpose obstacles to the advance of Science.

Healthy criticism can by no means be objected to; on the contrary, criticism, in the proper sense of the word, is the auxiliary of truth, and the means by which the true is differentiated from the false. But it surely cannot be called *healthy* criticism where the critic takes his stand under the banner of the *nil admirari*, and launches forth his thunderbolts of invective against the invader of his little realm of comfortable prejudices. Are we so very wise that we can afford to jeer at anything which is contrary to what we call the fixed laws of Nature? What, we would ask, are the fixed laws of Nature? Are they not simply the generalisations of human experience? And is it possible that Experience shall instruct us no more? Where are now the persecutors of Galileo, Bacon, and Vesalius? Is Newton still accused of dethroning the Deity? Or is Harvey's discovery of the circulation of the blood still stigmatised as having no foundation in fact, and of being the outcome of a diseased imagination? Calumny is silent, dead, and buried in the obscurity of the tomb, and in its place has arisen a feeling of gratitude towards those men who suffered so much for the cause of truth. "Nor," says Smiles, "is the unjust intolerance displayed towards men in the past without its lesson for the present. It teaches us to be forbearant towards those who differ from us, provided they observe patiently, think honestly, and utter their convictions freely and truthfully."

Let us, then, in dealing with any theories that may be opposed to our convictions, and which are subjected to our criticism, lay aside our opinionativeness, and, with a mind free from petty prejudices, set ourselves to examination and inquiry.

The mysterious and extraordinary nature of the subject we are about to discuss, together with the fact that many of its most wonderful phenomena have been associated in the public mind with the tricks of charlatans and impostors, render it a matter of peculiar difficulty for us to treat of it in a scientific and methodical manner. In pursuance of this object we shall at once plunge *in medias res*, without entering into a detailed history of the science, improperly so called.

Before, however, proceeding to ascertain, if possible, the established relations between the effect and its cause, we would say that the art which is now most generally comprehended under the name of Mesmerism is undoubtedly of very ancient origin, dating probably many centuries before the birth of Christ. Not that it then existed as a distinct agent, but, floating under various garbs along with the germs of Astronomy and Chemistry, it entered largely into the arts of Astrology and Magic.

It is not our intention, nor indeed will space permit us, to enumerate in detail the phenomena which characterise the effects of Mesmerism on the human system. Suffice it to say that by the application of artificial means, the *rationale* of which will shortly be discussed, it is possible to induce, in certain individuals, a state of trance closely analogous to Somnambulism, or sleep-walking, and characterised by the presence of phenomena of so marvellous a nature that, unless supported as they are by the most incontrovertible evidence, they would inevitably be regarded as fictitious.

We shall now proceed to the consideration of the supposed causes of those psychological and physiological phenomena which accompany that peculiar state of mind and body known as the Mesmeric Trance. These causes classified and enunciated take the form of two conflicting theories. The theory which first presents itself for examination—namely, that of Animal Magnetism, or Mesmerism proper—was first advanced by Anton Mesmer, a native of Musberg and an M.D. of Vienna, and has subsequently been promulgated by most votaries of Mesmerism. It is to this effect:—"There exists in Nature an imponderable fluid which can disengage itself from one body and be transmitted to another, and by means of which man is enabled to exercise over his fellow-creatures a singular and unaccountable influence." This fluid, which is supposed to resemble electricity in some of its properties,—namely, that of attraction and repulsion,—and in possessing two poles, is stated to be developed in the tissues of the human system by the decomposition of its molecular constituents, thus bearing an evident analogy to the manner in which the electric fluid may be produced. The body is, for various reasons, supposed to be not only a generating machine for this fluid, but a magnet in the proper sense of the word. If this be the case we may safely assume that any two selected points may be taken to represent the respective poles of the magnet. The hands, or distal ends of the upper extremities, are taken for obvious reasons,—viz., the nervo-electric fluid before alluded to is collected in the nerve-centres of the system, and, conducted by the nerves themselves, radiates to the general surface of the body. It is not then improbable that in the feet and hands, where the nerve-trunks break up and ramify so completely, the emanations from these surfaces will be considerable. This consideration, together with the fact that the hands form a ready means of transmitting the fluid, sufficiently explains the origin of the mysterious passes made by the operator over the body of the subject. In like manner it is supposed that this fluid passes from that great nerve-centre, the brain, along the optic nerves, to the eyes themselves, and from thence to the surrounding medium of air. It is further surmised that by the intense concentration of will this fluid is evolved in larger quantity, just as the amount of nerve-energy required to stimulate a muscle can be increased by an effort of volition. By attributing to this fluid some unknown reflex action, the advocates of animal magnetism attempt to account for the mesmeric phenomena.

Although to the eye of the superficial observer the above explanation may appear highly irrational, yet further investigation proves it to be not altogether unsupported by facts, and as such it demands our closest attention.

During the investigations of a committee of the Royal Academy of Medicine at Paris, appointed for the purpose of testing the accuracy of the mesmeric phenomena, it was observed that, in certain stages of the trance, the approximation of the fingers of the operator to any part of the body of the subject was attended with the production of involuntary muscular twitchings in the opposed surfaces. Subsequent investigation has confirmed these observations, and numerous facts of a like nature might be recorded,—*e.g.*, the application of the finger over the sterno-mastoid muscle causing contraction of its fibres, &c.

Now, in order to show the full significance of these facts, we must go a little into detail.

It is a well-known physiological fact that the contraction of a muscle is due to a series of extremely rapid chemical changes taking place in the muscle during the period of contraction. In order to supply material for these chemical changes the muscle requires nourishment. This it obtains from the blood. It is apparent, then, that in a properly nourished muscle, before contraction, there is an amount of energy stored up, or, in other words, the materials for the chemical change are there, but they require to be *stimulated* before chemical action can take place. How are they stimulated? By the nerve energy. This energy or force,—call it what we will,—passing along the nerve to the muscle, acts as a liberating energy or stimulus to set a-going this chemical change. Various other agents—*e.g.*, mechanical, chemical, thermal, electrical, and stimuli—are likewise capable of inducing these changes.

Now in endeavouring to account for the before-mentioned facts, for want of a better explanation we are forced to come to the conclusion that some species of energy, possessing the same power as electricity, but probably to a lesser degree, passes from the finger to the nerve, and either reflexly or directly stimulates the chemical molecules of the muscle, thereby causing contraction. This is, of course, a mere hypothesis, but the following experiment, which certainly seems to indicate the existence of such a fluid to a certain extent, enables it to assume the character of a certainty :— Several tumblers containing pure cold water are placed on a table a short distance apart, and passes are made over any one of them. The mesmerised subject, on being brought into the room, will, on tasting in turn the water contained in these tumblers, immediately recognise the one over which the passes were made, at the same time giving demonstrative evidence of his dislike to the water contained therein.

The above experiment we are thoroughly convinced is in every sense trustworthy, we having performed it several times, and in every case with complete success. It is mentioned in most works on Mesmerism, and is recorded by the late James Gregory, Professor of Chemistry in the University of Edinburgh, in his most interesting work on Animal Magnetism. Other experiments having the same end in view have been successfully performed, but are too elaborate to receive attention in a short treatise like the present. We may just mention that Gregory, Colquhoun, Reichenbach, and many competent authorities assert that to sensitive persons in the waking state, and the majority of subjects in the mesmeric trance, the emanations of this fluid are visible, appearing as faint luminous streaks of light shooting from the tips of the fingers. Our own experience, however, precludes us from passing an opinion on the subject, and it would therefore appear unphilosophical for us to adduce these statements as proofs.

The upholders of the anti-magnetic theory maintain that these phenomena are merely the result of the tiring out of that portion of the brain which presides over the action of the judgment, thereby rendering the will of the subject subservient to that of the operator. Their principal argument lies in the fact that it is possible to induce certain of the mesmeric phenomena by such means, viz., by causing the subject to gaze for a sufficiently long time at a fixed object, such as a coin. Starting from this particular premise, they proceed, by a train of reasoning as ingenious as it is fallacious, to the general conclusion that all the mesmeric phenomena are produced in like manner, the subject being (they state) placed under conditions in which there is a continued strain on, and consequent tiring out of, the mental faculties. Now, apart from the consideration that the explanation set forth in this argument is not calculated to throw the faintest ray of light on the remote causes of the psychical effects which manifest themselves in the higher stages of the mesmeric trance, it is hardly necessary to state that it is opposed alike to logic and common sense. It assumes that because certain phenomena are produced by certain means and under certain conditions, therefore it is a physical impossibility for the same phenomena to be produced by other means and under other conditions! What if we were to argue that because complete insensibility may be occasioned by pressure on a certain portion of the brain, it must follow, as a necessary sequence, that it is impossible for chloroform to produce the same effects, or, granting its ability to do so, its action must be to produce compression of that part! Would it not be said of us that we were sadly deficient in regard to that very necessary article—*nous?*

Nothing is further from our intention than to deprecate the fact that the mesmeric trance may be produced by the above means. We simply wish it to be understood that, besides occurring naturally, the trance may be produced by other means, and that it is not improbable that both these means are adequate to the effect. This is further borne out by the fact that patients may be mesmerised when asleep, and consequently under conditions entirely different from those which are necessary for subduing the action of conscious volition. This is no fiction; it is a fact, and is attested to by men whose honour and integrity are above suspicion.

When we consider the energetic nature of the opposition which has at all times been brought to bear against the theory of animal magnetism, we are inclined to think that there must be other reasons than these for denying the existence of this fluid. Are there, let us ask, any theoretical grounds for supposing that such a fluid can have no existence? Are there any reasons why, physiologically, it should be impossible for a fluid possessing these properties to be connected with vital organisation? Is there not direct evidence to the contrary? Are you not aware that in your own body, whenever a muscle contracts, whenever nerve energy is propagated, and in all probability whenever an idea is generated, electricity is evolved? Take also the case of the electric ray, or torpedo, a fish possessing the remarkable power of discharging, when irritated, powerful electric shocks. Regarding the electricity produced by this animal, Prof. Alleyne Nicholson thus observes: "The identity of the force produced in this way with the electricity of the machine has been demonstrated by many careful experiments. . . . There is no doubt, however, that the force which is expended in the production of the electricity is merely nerve force, for every equivalent of electricity which is generated the fish loses an equivalent of nervous energy' and for this reason the production of the electric force is strictly limited to the amount of nerve force possessed by the animal."

Again, in his concluding observations on the electric eel, Humboldt remarks, "That which constitutes the invisible weapon of these inhabitants of the waters; that which, awakened by the contact of moist and dissimilar particles, circulates through all the organs of animals and plants; that which, flashing amid the roar of thunder, illumines the wide canopy of heaven; which binds iron to iron, and directs the silent recurring course of the magnetic needle—all, like the refracted rays of light, flow from one common source, and all blend into one eternal all-pervading power."

That mysterious and occult influence the consideration of which has occupied the greater part of this paper is considered by many authorities to constitute what is known as the "*Vis Vitæ*," or vital principle; but this view is hardly acceptable, and whether in its ultimate essence it is merely a subtle modification of the electric force is a question which, in the present imperfect state of our knowledge, we are not justified in answering. The fact is that here we reach the legitimate boundary of fact, and beyond the demonstration of the existence of this fluid, and its probable connection with the mesmeric phenomena, all else is mere speculation.

For many years animal magnetism has been in vogue as a curative agent, but qualified medical men are averse to its practice, and, from the unsatisfactory nature of the results which frequently attend its application by empirics, we doubt very much if its use should be recommended.

The immense amount of light which the study of Mesmerism is calculated to throw on the science of Psychology ought to be a sufficient inducement to us not only to collect facts, but to study, and if possible to classify, them. Let us not remain satisfied with the meagre information we already possess, nor leave to future investigators a task which it is our duty to perform.

IV. PLEADING FOR A GEOLOGICAL IDEA.

By O. Reichenbach.*

Amendment to Laplace's Nebular Theory.

A NEBULA with unconfined room for expansion has no high temperature. The generation of a stellar system requires centres, solid atoms, to begin with, which, by exchange of attraction and repulsion, assign limits to the nebula, and by concentration of matter and increase of empty space produce oscillations of temperature, regularity of motions, composition, decomposition, and transformation of atoms and molecules. The beginning of a solar system is therefore not the concentration of a sun within detaching rings rolling up to planets, but the opposition of solar and planetary centres, round which matter gets grouped into rings divided by more or less empty spaces, and into strata separated by nodal bands.

A nebula must be either a collection of smallest spaces growing force from nothing, or a collection of such spaces set free by the collapse and death of such systems productive of heat, of high molecular centrifugality, of decomposition of mass, and of compound and simple molecules and atoms. Such a nebula, with re-incipient evolution, will produce heat and light by again passing into condensation, transformation, and combining motions.

Spectral analysis therefore confirms that the more diffuse and without centres a nebula appears, the more backward it is in evolution, the more primitive are the substances composing it, and the less is its volume of motion, the volume described by its translatory motion in space, and the velocity of such motion.

Generation of a Solar System.

A solar system is engendered by the action of two or more systems on nebula in its nascent state. The planetary mass of our system, opposed to the solar mass, became divided in a manner and order described by me in "Gedanken," 1857, p. 113, and in "Two Planets beyond Neptune," 1875.*

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* As contained in "Some Properties of the Earth," by O. Reichenbach, published by Wertheimer and Lea, Finsbury Place.

The evolution of the system progressed by atomic and molecular union, which consisted not only in the development of new combinations of single and compound atoms and molecules, but in the combination of simple to simple atoms, embracing within a smaller space the same measure of attractive force as in the sum of spaces of greater volume formerly occupied by them.

I have shown that molecules consist of rings, of strata round one or more centres or nuclei. I have shown that the evolution of masses acting on each other in vacuum develops similar results.

I have shown that the sun moves, in probably 11,500 years, round an immaterial centre, in an orbit whose eccentricity and extent is determined by itself and by planetary action. This solar year has its apsidal and latitudinal seasons, because the orbit is eccentric and the orbits of the planets are inclined to the equator of the sun.

I have pointed out, in speaking of heat and light, the existence of an interchange of matter between heavenly bodies, which is besides evident by the fall of meteors.

Catastrophes.

I have shown the part played by the relation of solid and fluid masses in the eccentricity of orbits of planets and molecules, and the changes that must occur in solids, liquids, and gases in passing from state to state. I have shown that such changes lead to catastrophic phenomena in and between molecules, and in and between stellar masses.

Every inorganic or organic individuality or species has the more quick course of its development crossed by sudden changes. Are not begetting, birth, teething, the first word after the habit of hearing, manhood, death, catastrophes?

When the attraction of a planet or a comet, added to that of the sun, may alter a hyperbolic or parabolic course into an ellipsis or a spiral leading to sun or planet, the accelerating attraction of sun and planet may cause such an increase of rotation,—that is, of heating of the inner solid comet,—and such a relative increase of the quantity and pressure of its fluid portions, that the comet going to perihelion gets divided or dispersed, or may have its progressive motion reversed, or its elliptic orbit made parabolic or hyperbolic. The division of Biela's comet in 1846 has demonstrated that my hypothesis ("Weltgebaurde," 1845, edt. Bauer), that our earth is the offspring of a larger planet, was no absurdity.

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* To be found by those who care at the British Museum. From them it may be learned that Dr. G. H. Darwin's theory that our moon is the offspring of the earth, admired by Professor Ball, and made the start for a too hasty speculation by the Rev. Prof. Fisher, is not quite new. What is true and what is erroneous in the application of the theory by Dr. Darwin I shall not here discuss.

Birth of Moons and Rings.

I have shown why and how the earth moved in a most eccentric orbit, intertwined with the orbits of other planets, and threw off Mercury. I have shown how after a time, in moving in a less eccentric orbit, it gave birth to our moon.

After the separation of the moon, when the eccentricity of the planet and of its orbit was diminished yet considerably, it turned off rings. Saturn, the least dense of planets, proves that such rings may exist. The turning off of rings was a series of catastrophes for the earth and its molecules.

The leaving of moons and rings is likely to occur in the equator of the planet, but it need not be, because the equator is not of absolute necessity the plane where centrifugality is greatest. Any inequality of mass of the planet to the sides of the equator, or any outside attraction not falling with its maximum in the equator, must produce an inclination of the plane of motion of the satellite to the equator, and therewith a continnous oscillation of the respective planes.

Moon or ring need not revolve in the like sense as the planet, because at the time of the catastrophe the inequality of mass and density, and state of substances, originally and by position of sun and disturbing planets, may have been so great between the polar hemispheres that the increased centrifugality operated in preference on one hemisphere, what resulted in such a height and velocity of descent of the overbalancing mass towards the equator, and consequently in such a pressure and velocity of parting ascent (velocity in a polar trajectory) on the other side, that the separated mass acquired an orbit with so great an inclination to the equator of the progenitor that the motion of the globular or annular satellite, itself less dense than the central body, became retrograde—a condition which may become reversed after condensation and reduction of inclination, and a modification in the relative proportion of masses and densities of the two bodies. Several observers think that the volume of Saturn to both sides of its rings or its equator differs considerably. Similar observations were long ago made by Schubert with regard to Jupiter.

Displacement of Axes.

A displacement of weights external to the planet must produce a reciprocal displacement of density and weight within the planet, and a displacement of its axes in space. Take a planet covered by liquid, and assume solid and liquid to have at starting the axis of revolution in common: any disturbance of the distribution of the liquid by an outside mass will break the continuity of this common axis, because the densities and compressibilities of solid and liquid differ. These changes must occur when a shell is divided from a nucleus by one or more strata of more elastic nature than either, and when the shell experiences from the outside or inside perpendicular and tangential pressures which produce friction, heat, chemical action, alternations of solidity, liquidity, and gaseity, and metamorphism through a condensation of the interior below a contracting outside. A mass condensed at the outside in its aphelion period may produce moons and rings in its perihelion when the interior is compressed and the outside expanded.

Condition of Rings.

The rings are composed of solids, liquids, and gases: they are closed zones, separated from the central mass by vacuum. After separation the tendency to reunion commences. The rings condense by molecular changes; they cool; they intercept the rays of the sun, but are compressed by its centrifugal reaction and by its co-attraction with the planet; they congeal; the solids gain in proportion to liquids and gases.

The central mass also cools. It gains less in velocity of rotation than it gains in density. It gains in velocity of motion round the sun; the orbit contracts, and with the sun in space. Centrifugality at its surface becomes a less percentage of attraction, the volume within which gravity exceeds centrifugality gets extended, and finally overreaches the contracting ring. The ring gradually descends and falls, starting for the planet at aphelion time; it becomes contiguous to the planet as a catastrophic rain, as a cataclysm with liquids, solids, and gases. It brings on a period of meteor showers, earthquakes, electric commotions, and magnetic constitutions.

Such joining of a ring must modify the revolution of the ring and the rotation of the planet. It must alter the eccentricity, and even the mean axis of the common orbit round the sun.

Spreading of Rings.

Such a descent of mass produces friction and heat. Molecular centrifugality is developed, and tends to again lift the ring from the planet where centrifugality is greatest. The mass of the lifted ring is re-attracted towards those parts where centrifugality is least, towards the higher latitudes and polar extremes, from where it again streams and tends towards the equator. Its fluid matter circulates round the planet. The ring becomes an envelope, which divides and settles according to specific weights and molecular qualities and affinities, and becomes a new shell, and sea, and atmosphere, under the attractive influences of the planet and the perturbing sun.

Tangential Action of Rings.

The fall, spreading, and revolution of the ring, growing into an envelope, constitute in contact with the planet, under the perturbing action of the sun, a combination of tangential forces, which, in proportion to the weight and motion of the new ring, operates on a corresponding envelope or section of the older planet. It develops and maintains friction and heat below this section. By the heat they produce these tangential forces soften, liquefy, and gasify, expand, lift, condense, compress, and metamorphise below the old envelope, and which they so fold, plicate, push, shove, and partially lift. The descent of ring after ring is a series of catastrophes divided by developing modifying periods.

The own eccentricity of the planet constitutes the leverage by which the descending, slower and slower revolving ring acts on an envelope of a weight proportional to the weight and motion of the ring.

Sliding of Envelope.

Most geologists consider it absurd that a solid envelope, or series of shells, of which the lower have partly penetrated the upper ones, resting on an elastic, locally yielding, and rising liquefying interstratum, has slided, and slides partly and together, most slowly over a nucleus.

Does not stone turned on stone, by wind or water, produce heat and do work? Have not those ice sheets about which we hear so much and know so little slided and grinded, solids over solids, heating and melting below them by weight, and by height and velocity of descent, and by interception of heat, radiated from the inferior solid? What difference is there in all this between ice and azoic rock but the degree of heat required for melting either?

The ring developed into a globular envelope moves at contact round the planet. It forms with it a vast kind of a compound—not yet of a simple—molecule of not accidental proportions and characteristics.

Every geologist speaks of folds of every thickness and extent—feet, miles, mountains. The continents are the folds of an envelope over an earth limited in the mass by the revolution of a plane curve. It is impossible to form folds over such a body without that every molecule composing them slides away from that radius in whose prolongation it was situated. When every molecule must slide, the folds, the continents, the envelope must slide, it is tangentially pushed and drawn.

The pushing and drawing, and the resistance to either, vary in direction and periods for any and all of the strata. Folds form, unfold, and reform, like waves; new shapes and directions arise within and under, forming and transforming sediments and denudations.

What I show.

I show in which manner the folding and sliding has proceeded and proceeds. The theory that a shell, formed over an intensely hot fluid, broke and drifted like floes of ice on a pond moved by wind, and again baked to a sea-bottom, and piled up to continents helter-skelter, is a sham. The earth is not a rotten cringed apple; and even an apple does not rot and wrinkle without an order in the causes of disintegration.

I show that our continents amidst our seas have been formed gradually and regularly, according to physical laws, by orderly working forces, and that this order has produced a symmetry of arrangement which may be made visible and intelligible to every educated mind not blind and deaf by professional pride or envy, or in the heart's heart disposed to prey with plagiatory instincts on the fragments of a work incomprehended in its fulness.

I show, and shall show, that this development with its catastrophes throws lights on the probabilities of the origin and evolution of organisms brighter and truer than those of natural selection, howsoever dim Will-o'-the-wisps they may also be, and remain to guide us in our knowledge of the eternal infinite.

I refer to certain globes and maps, and point out the visible, about which there can be no spirit-knocking imposture, sometimes attracting the learned. It has all the authority of experiments performed by untutored Nature in its boundless laboratory; it presents all the diffractions and interferences of manifold laws, sprung from an universal law.

Should anyone say of this or that regularity or coincidence "I had seen it, I knew it," I ask where and when did you say so? And if there should be a sufficient reply, I shall gainsay you said so after my time, and never traced the origin and connections of such fact, the "*encheiresin naturæ*." I did not pick up these facts, suggestive of greatest probabilities, as the schoolboy does the capitals on the map. I got at them by reasoning more intricate than that which led the grandly adventurous spirit of Columbus to search for the ancient East by sailing West; and when a definite point had been gained and was confirmed by the visible I went on.

I maintain that there is law and order on earth and in heaven more than sought for and expected, and to all who might venture to pronounce that password of ignorance, Accident, I tell—Pythagorean ideas and the teachings of Aristarchus of Samos were rejected, suppressed, and silently made away with by orthodox Science. Ptolemean muddle, not without meritorious art, dominated in the progress of doctors and the creeds of the faithful multitudes. Copernicus finished his "De Orbium Cœlestium Revolutionibus" in 1530, but the instinct of self-preservation made the high ecclesiastic delay its publication to the hour of his death, in 1573. Galileo Galilei had to repent for his "Dialogo," of 1632, to the end of his days, in 1642. Kepler led the life of a vagabond after his "Astronomia Nova" appeared in 1609, and he starved in 1630. Tycho Brahe, the contemporary, the great observer, saw that the orthodox system was wrong, but jealousy urged him to oppose the progress of truth by own errors. Statues they now all have.

V. DISTINCTIONS BETWEEN ORGANISMS AND MINERALS.

CERTAIN recent investigations have shaken, if not altogether overthrown, one of the most striking distinctions between the inorganic and the organic worlds. Suppose we take up one of those bodies in which dead matter is individualised, *i.e.*, a crystal. We perceive at once that its surfaces are planes, bounded by right lines.* We may by grinding and rubbing bring such crystals into rounded forms, and nature may effect the same if the crystals lie in the bed of a rapid river, or on the shore of the sea. But these forms are essentially artificial, and are never assumed when inorganic matter is left to crystallise. On the other hand, if we take an animal or a plant and examine its shape we find that save in some of the lowest groups it has exclusively rounded surfaces, spherical, spheroidal, ellipsoidal, cylindrical, &c., and that its outlines are curves. This distinction between the living and the lifeless is so striking that it was once proposed to view the development of animals and vegetables as a process of curvilinear crystallisation, peculiar to certain kinds of matter when placed under proper conditions. The immense mathematical difficulties involved were the reason why the idea was never worked out.

Again, if we break, cut in pieces, or otherwise dissever a mineral and an organism we find that their respective differences of structure are not confined to the outer surface. The disintegrated particles of the mineral body are each solid; each, if cut or broken, consists, within and without, of the same kind of matter. We may find in minerals, *e.g.*, asbestos, a fibrous structure, but such fibres are not tubular, and never contain either a fluid or any solid body differing in composition or in structure from the outside layers. In the organic world all this is otherwise. If we examine the intimate structures of the plant, or the animal, we find tubes, sometimes hollow, sometimes containing a fluid, or sometimes a solid matter differing in its nature from the enclosing walls. We find also round or oval vesicles known as cellules and generally containing fluid matter. These well-known contrasts are presented here in the briefest and most sketchy manner, not as being in themselves novel, but as necessary to be borne in mind for the understanding of what is to follow.

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* The partial exception in case of the diamond—carbon—is insignificant.

In February, 1878, M. Georges Fournier, of Paris, performed, in presence of Mr. W. Crookes, F.R.S., and of the present writer, some most remarkable experiments. By mixing together certain inorganic salts he produced pseudo-organisms which, in form and structure, might easily have been confounded with certain cryptogamous plants by any one who was not acquainted with their origin. In the belief that M. Fournier was continuing his experiments we considered it a duty not to make his results known in a premature and necessarily incomplete state. It was, therefore, with regret and surprise that we saw in the "Comptes Rendus" for January 2nd, 1882, a memoir by D. Monnier and C. Vogt, a translation of which follows:—

"Figured elements presenting all the characteristics of form belonging to organic elements, such as cellules, simple and with porous channels, tubes with sides, with septa, and with heterogeneous granular contents, may be produced artificially in an appropriate liquid by the joint action of two salts forming by double decomposition one insoluble salt or two such. The one of these salts must be dissolved in the liquid, whilst the other must be present in a solid form.

These organic elements, cells, tubes, &c., may be produced either in a liquid of organic or semi-organic source such as the saccharate of lime, or in an absolutely inorganic liquid, *e.g.*, silicate of soda. Hence there can be no longer any question of distinctive forms characterising inorganic bodies on the one hand and organic on the other.

The formation of such pseudo-organic figured elements depends on the nature, the degree of viscosity, and the concentration of the liquids in which they are produced. Certain viscid liquids, such as solutions of gum arabic, or of zinc chloride, yield nothing of the kind.

The form of these pseudo-organic products is constant with reference to the salts employed, as constant as any crystalline form of minerals. This characteristic form is so well maintained that it may even serve for the detection in mixtures of a minute proportion of a substance.

The form of the artificial pseudo-organic elements depends principally on the acid which enters into the composition of the solid salt. Thus the sulphates and the phosphates produce tubes, whilst the carbonates give rise to cellules.

With some exceptions, such as copper, cadmium, zinc, and nickel sulphates, the pseudo-organic forms are only produced by means of substances which are found in real organisms. Thus the saccharate of lime produces organic forms, whilst those of strontia and baryta do not.

The artificial pseudo-organic elements are enveloped in true membranes possessing a high degree of dialysing power, and giving passage merely to liquids. They have heterogeneous contents, and produce in their interior granulations arranged in a determined order. They are, therefore, in form and constitution, absolutely similar to the histological elements of organic beings. It is probable that the inorganic elements contained in protoplasm play a certain part in the constitution of the figured organic elements.'

The close similarity, both of the means employed and of the ends reached by these authors, and by M. Fournier, is very interesting. Silicate of soda was one of the compounds used by M. Fournier, and salts of nickel played a prominent part in some of his most striking results. After having thus vindicated the claims of my friend I must attempt to show some of the bearings of this discovery.

It must be admitted that the structures produced are merely pseudo-organisms. They manifest none of the phenomena of life. They do not take in, assimilate, and excrete any kind of matter. They do not propagate. Nor does it appear that if carefully preserved under constant conditions they might not continue to exist for an absolutely indefinite time. They have, therefore, no vital cycle —no periodicity.

Nevertheless we must note the points in which they seem to link the organic and the inorganic worlds together. As MM. Monnier and Vogt urge one of the characters by which mere lifeless matter was till yesterday differentiated from the living organism is wiped out. There are no longer any distinctive forms by which we may distinguish the two great classes. Here a new thought will suggest itself to every reader: these pseudo-organisms have, so far as we know, been obtained experimentally only by M. Fournier, and by MM. Monnier and Vogt. But is it not very possible that such structures might be produced without human intention and interference in what we call an accidental manner? Might they not, considering the large proportion of silica which they contain, become preserved for ages, and continue to display pseudo-organic features? Suppose we find in a rock certain structures exhibiting apparently organic cells, are they the remains of true organisms or of pseudo-organisms? This consideration—at least till it has been further studied—is not without its bearing upon such questions as the organic or mineral nature of the structures found in meteorites, and, *e.g.*, of *Eozoon Canadense*.

It is highly significant that, with certain exceptions, the rationale of which may become clear on future scrutiny, only those chemical elements which occur in natural organisms are able to take part in producing these pseudo-organisms. Chemists fully recognise the close analogy which exists between lime, strontia, and baryta. Yet whilst the saccharate of lime lends itself to organic formation the corresponding salts of strontia and baryta are excluded. This consideration is of grave import. It would seem to follow that certain chemical compounds are capable and naturally tend to produce organic structures, cells, tubes, &c., under certain conditions just as under others they give rise to crystals. But MM. Monnier and Vogt have gone even further, and have been able to specify the classes of structures which different compounds may form. They state that sulphates and phosphates originate tubes, whilst the carbonates give rise to cells. May not these facts have their meaning, to be traced out perhaps in some country where biological research is free? May they not throw light upon the functions of different classes of salts in the process of nutrition? Has the attempt been made to quicken these pseudo-organisms into a higher stage of existence by the application of varying conditions of atmospheric pressure and composition, of light, temperature, &c.? At any rate these growths seem to be, from a structural point of view, a transition-stage between the unequivocally inorganic and the decidedly organic and vitalised. It is conceivable at least that such has been the path taken by Nature.

Apart from all special scientific considerations the experiments of MM. Fournier, Monnier, and Vogt have a philosophical value as confirming the principle of continuity.

We must take the liberty of here calling attention to certain researches which, though not in direct connection with the experiments of M. G. Fournier and of MM. Monnier and C. Vogt, serve in some degree to lessen the gap between the organic and the inorganic worlds, or at least to throw light upon the cause of life from a chemical point of view.* Our readers are, of course, aware that sixty years ago all organic compounds were supposed to be due to the action of a distinct vital force, and to be quite incapable of artificial production. In 1828 Woehler succeeded in constructing urea from dead matter. Since that time not a few organic compounds, formerly obtained only from plants and animals

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* Die Chemische Ursache des Lebens, Von Oscar Loew und Thomas Bokorny. München: J. A. Finsterlin.

—such as alizarine, indigo-blue, vanilline—have become laboratory products. But chemists have failed in the synthesis of the more characteristically vital compounds, such as albumen. Further, till the year 1875, the idea of a chemical distinction between living and dead protoplasm was not even conceived. Prof. Pflüger ("Pflüger's Archiv.," x., p. 251) advanced the opinion of a necessary chemical difference between protoplasm in these two conditions. It may be well here to remark, for the benefit of such readers as are not conversant with modern bio-chemical research, that protoplasm is not an abstract idea or a mere theoretical body. It is a substance which can be obtained from certain plants—*i.e.*, *Ethalium septicum*, and submitted to the investigations of the chemist and the microscopist. The idea was taken up by HH. O. Loew and Thomas Bokorny, of Munich. The former of these chemists in establishing a rational formula for albumen was struck by the circumstance that it contained a number of aldehyde-groups immediately bordering upon amide-groups. Such groups, according to modern chemical philosophy, must be distinguished by intense atomic motion. Hence, argued Herr Loew, this motion constitutes life, whilst the respective displacement of the aldehyde and amide-groups, and the necessary cessation of the atomic motion involves death, it may be of a mere molecule of protoplasm, or of a larger portion, or of the entire animal or plant. Now, so far, we have to deal merely with a theoretical assumption. This point requires, therefore, a little further explanation. The methods of the astronomer are utterly unintelligible to the majority, even of educated men. But when an astronomer on theoretical grounds predicts the existence of a hitherto unseen planet, and another, turning his telescope to the spot, discovers it there as foretold, the public is forced to admit that the hypotheses of astronomers deserve a great degree of confidence. Very similar is the case with the speculations of the chemist: no man has seen a molecule, much less an atom. No man can say, on the direct evidence of his senses, that in a molecule the atoms are arranged in this or the other manner. Nor has anyone witnessed the more or less rapid vibration which the atoms in a molecule, or the molecules in a compound body, are inferred to undergo. But when we find chemists setting out from these assumptions come not by chance but intentionally to such results as the formation of artificial indigo, they are entitled to claim for their assumptions at least provisional acceptance.

HH. Loew and Bokorny, however, were not content without testing their supposition experimentally. They found that living protoplasm has the power of reducing silver from a very dilute alkaline solution, whilst in dead protoplasm this property is wanting. By dint of a long course of investigation they determined that this reduction could be due merely to the presence of the aldehyde-groups in the protoplasm whilst living. In living protoplasm the aldehyde-groups of each molecule are brought in immediate proximity with the amide groups of the next, and thus a considerable intensification of the vital molecular motion ensues. But with increasing complexity and motility follows increasing instability. Apparently trifling agencies displace the molecules and their action ceases. During every such molecular displacement, which is in fact a combustion, heat is liberated. Hence the rise of temperature in fevers, and that which occurs upon death. On the other hand, when lifeless albumen is assimilated and converted into the protoplasm of a living cell, heat becomes latent. The absorption of oxygen, and the formation of carbonic acid, in short, the whole process of respiration, becomes intelligible, since it is admitted that an increase of molecular motion promotes chemical action and consequently oxidation. Vital force, Herr Loew considers to be, in short, reducible to the tension of the aldehyde groups ultimately due to electric differences. Life is the total result which the protoplasmic structure yields by means of such vital force. Space does not allow us to reproduce here the experimental evidence which the authors here set forth in support of their theory. They trust that at any rate the first step has now been taken towards explaining the numerous mysteries which appear in the manifold functions of protoplasm. Even the cardinal problem, the first origin of protoplasm upon our earth, seems to them only a question of time.

Whilst wishing the authors good speed in the arduous task they have in hand, and whilst admitting that they have laid down a fair working hypothesis on the nature of life, which must stand or fall by its results, we wish to point to one difficulty. They appear to regard albumen and protoplasm as substantially identical in composition. Now, according to the analyses of Reinke, referred to in the "Journal of Science" for 1881, p. 182, protoplasm contains scarcely 30 per cent. of albuminous matter, and contains upwards of 40 proximate principles. The question now arises whether all these principles are truly components of the protoplasm molecule?

VI. ON TECHNICAL EDUCATION.

By Robert Galloway, M.R.I.A.

TECHNICAL Education is still a subject little understood, not only by the general public, but likewise by not a few Members of Parliament, and by some of our leading Statesmen: they confuse and jumble together, whenever they speak or write on the subject, the technical education required by the workman and the technical education required by directors of industries, whether masters or managers. We shall discuss these two forms of technical education separately, and in doing so we shall not confine ourselves to education pure and simple, for the subject requires to be treated in a much broader aspect at the present time. We shall have to notice the defective machinery we at present have for carrying out technical education; for defective it is admitted to be by the present political chiefs of the Education Department, by Members of Parliament, by our manufacturers, and by many scientific men, otherwise the recent appointment of a Royal Commission to inquire into the methods adopted for imparting technical instruction in Germany, France, and other continental countries, would have no meaning; the Commission has been appointed avowedly to inquire into the systems of technical instruction on the Continent, with the object of improving our own.

Concurrently with the investigation the Commission is making, negotiations have been proceeding between the Governments of England and France for the ratification of a new commercial treaty; and the difficulty which stands in the way of a satisfactory termination of the negotiations is due, as most people know, to the excessive import duties which the French Government wish to levy on many of our manufactured goods, whilst we admit their goods free of duty. And it is not alone, as many suppose, on goods that require for their production little human skill, but also upon manufactured articles that require considerable skill in their manufacture. What transpired at the meeting, on the 14th of November last, between the silk-weavers and the Under-Secretary for Foreign Affairs, Sir Charles Dilke, with respect to the Anglo-French Treaty, affords a very good illustrative example.

Mr. Buckingham, who introduced the Deputation, stated that "the silk trade of Spitalfields was divided into several interests. There were the broad and narrow weaving, the velvet weaving, the figured silk weaving, the upholstery weaving, and the trimmings; all of which would be affected still more by the proposed new treaty, unless something better were done than existed at present. All English articles of pure silk were admitted free into France; but during the last twenty-five years competition had been so keen, in consequence of England admitting every article of silk manufacture free, that our manufacturers were put to their wits' ends to know what to do to meet the severe character of that competition, and also the great demand for cheap articles. The consequence was that in the velvet industry, where cotton was used in its manufacture, the foreign manufacturer—particularly of France and Germany—was able to compete with us on better terms than we could do; because as soon as cotton was introduced into the article of velvet manufacturing, *we were shut out from every other country by systematic high duties.* Consequently velvet goods were things of the past; and the competition went through the whole length and range of the silk manufactures, and there was not a single article now made in Spitalfields but could be increased by the use of cotton, *if France allowed the British article to enter upon the same terms as we admitted the goods of France.*" Producing several splendid specimens of work turned out by the weavers of Spitalfields, he said that, "in face of fair competition with France there would still remain a fairly large industry left to the British weaver. When our manufacturers," he said, "employed French silk, on which, of course, they had to pay carriage, and manufactured an article of it mixed with a very small proportion of cotton, and sent the article to France, a duty of 15 per cent was placed by that country upon it. Competition and fashion compelled them to use more cotton than silk, and because of that they were charged 25 per cent upon their productions. Every manufactured article with silk dominant was charged 15 per cent, and every article with cotton dominant was charged 25 per cent duty."

The fact, of which the above extract from Mr. Buckingham's statement is but a single illustration, that none of the continental nations, nor America, will enter into free and equal competition with many of our manufactured goods, but require their own manufactures to be protected from ours by levying on our goods heavy import duties, cannot be left out of view in proposing or considering improved systems of technical education for our own artisans. Other countries admit they cannot compete with us on equal terms, either as regards quality or price, with most articles we manufacture; and it must be borne in mind that we have placed their manufacturers on perfect equality with our own, by allowing them to have, duty free, our raw materials (as coal) and our unfashioned materials (as crude iron), which they, like ourselves, fashion by means of high class labour, into articles which enter our country free of duty, whilst ours are excluded, or all but excluded, from theirs by heavy import duties. It is sometimes alleged, by those who take an unfavourable view of the skill of our craftsmen, that not a little of the excellence of some of our productions is due to foreigners being the managers of these industries. But if the apprenticeship schools are making the foreign artizan superior to our own in every form of handwork, then the goods produced, whether as regards quality or price, by the combination of foreign workmen and foreign managers, ought to surpass those produced by a combination of our own artizans and foreign managers, especially as foreign manufacturers have free access to our raw materials, and have the command of cheaper labour.

It must be evident, at least to those who have given thought and attention to education, and to British and foreign manufactures, that the establishing of technical workshop schools in this country, similar to those established on the Continent, is not likely to be the best or correct plan for improving the technical education of our own artizans. They are superior to the foreign artizan in many kinds of technical skill; they require, therefore, an instruction suitable to their needs, as the artizans of foreign countries require one suitable for the conditions they are placed in. But if anything practical is to follow from the Reports of the Royal Commission, the scheme or plan proposed and the machinery for carrying it out will require very careful consideration. If the plan proposed is a mere copy, it will most likely fail; it is essential, in framing a scheme most suitable for English workmen, to consider the advantages they possess, as well as the disadvantages they labour under, compared with foreign artizans in acquiring technical skill; and the differences in mental aptitude displayed by the two classes ought also to be taken into account in its construction.

VII. THOUGHTS ON MY NEWLY-COMPLETED TABLE OF EARTHQUAKE COMMOTION AND SUN SPOTS.

By A. H. Swinton.

WHO that has been brought up in wholesome dread of the three books of Euclid, logarithms of China, and two calculi of our Gallic neighbours, but experiences a most dreadful qualm when an astronomical topic is mooted. And truly the present state of physical science, as displayed by a good text-book on the subject, is by no means cheery or inviting to a naturalist. As in ancient days an attempt to solve the apparent motions of the heavens ended in a Gordian tangle of spheres, circles, and triangles, so I am much afraid now-a-days nature bids fair to be eclipsed under a blur of conic sections, values of the function of *x*, long columns of figures, and a most terrible nightmare of micrometers, frightful to our eyes as was that picture of the torture of the wicked in a burning sun, that nightly awoke before the old monk's conscience in the arcanum of his mediæval crib.

Indeed, this spring, when I wrote, unwittingly and in the form of conjecture, a partially correct statement of the connexion that exists between the periods of seismic disturbance and the sun spot periods, to the editor of the "Daily News," I had then not the slightest idea that some weeks thence, I should find the whole of this much perplexed subject resolving itself back into that beautiful image of natural harmony and proportion that every lover of science kindles at the sight of.

No surer does the shadow on the wall, or hand on the dial-plate, mark in turn the time-honoured numerals of the Romans than do these black spots on our sun's disc indicate the periods when the face of the globe is to be convulsed by the cycle of volcanic eruptions and earthquake tremors. Maximum and minimum, minimum and maximum, they recur, back to the time when Columbus opened up the great physical history of a New World.

From this date, indeed, we first really see the round world as it actually is, and gain power to generalise and tabulate these disturbances; and by so doing, we not not only find that we are enabled thereby to construct a seismic table, but we likewise gain a pretty exact idea of the sun spot wax and wane, from those hours until the present disastrous phase, when the issue of "Whitaker's Almanack" is as black with earthquake phenomena as the sun has been dim with maculæ.

Why, then, we may now ask, Is the moon pitted over with huge volcanic mountains? And the answer is plain. Simply because more exposed it is baked and frozen in turn until its bronzed surface has become all cicatrised over from the alternate contraction and expansion of its soil, and its history has become as indelibly written in sun tremors as the story of this globe is told in billowy hills and up-turned strata.

All this I learn from my seismic table. To-day I have accomplished a feat, and entered on a region imperfectly, if at all, known. I have constructed a table showing the years of maxima and minima sun spots between 1880 and 1500, with a good index to others, reaching back to the year 0. As I look upon this little history of this great earth before telescopes and rain-gauges were, I seem to see the shadow on the paper of those great laws that rule the nebulæ of suns, that hang out on dark space like mackerel clouds in the evening stillness. But the matter in detail is prosaic. During the period in which I have indicated the work of chronicling as the more feasible, I discover the differences intervening between the known sun phases in Wolff's table will point the periods of commotion back to 1500, and that, although I get no recurring differences accurately speaking, here and there, there come on, in a remarkable manner, certain long periods when the lapse between the maximum and minimum of spots is 10, and this, likewise, at stated intervals. 1788 to 1798, 1657 to 1667, 1521 to 1531. These dates, as far as I can determine, fairly signalise the maxima and minima points of the progressive change in the east and west variation of the magnetic needle. Otherwise, there is a great uniformity presented in the cycles. Between 1855 and 1755 the number of epochs of the maximum and minimum of spots works out as 18, between 1755 and 1655 the same, between 1655 and 1555 the same. This result, I should state, is given wholly by the breaks in the seismic tables, and I gain much confidence in my work from the circumstance of this same uniformity.

It will thus be seen that the dependence of the greater cycles of terrestrial magnetism, indicated by the east and west deviation of the compass needle, is indicated as being dependent on the shorter sun spot cycles. May it not, then, be likewise that the inclination of our globe to the sun, as determined from the precession of the equinoxes, has likewise been enacted in great dependent cycles. If so, we might think to see the resolution of the crude Newtonian theory of gravity and squares of the distances, into a known harmonious reality—electricity; and the sun, from its late execrable conduct, would take its place then among the worst regulated of magnetic lights.

And now another matter. If earthquakes and volcanoes are in activity at the minima and maxima of sun spots, and their period coincides, as in spite of previous conviction I now own with these epochs, the phenomenon must, as I before intimated, be considered as due both to the expansion and contraction of the earth's crust, rather than to its secular contraction, as is often stated. This, also, is the only aspect of the question which is true to work upon. It might likewise appear to some that, however fair the reasoning from the known to the unknown might be, a seismic sun spot table, constructed from the data furnished by igneous commotions alone, might want checking by other and independent phenomena. Here, of course, the laborious searchers in old records are again in request, and each branch of golden sun lore has to be culled from out the dusk of the monkish cell and archives of the past. My own predisposition has been greatly for biology, and when writing my late work, "Insect Variety," I was led to recognise the fact that the multiplication of locusts in southern Europe recurred regularly at each epoch of minimum sun spots, and that their dissemination northward, and final disappearance, ensued on the arrival of the succeeding maximum season. Any way the period is always marked, and communications on this subject have been already made by me to the daily papers, the "Journal of Science" for August, 1881, and more lately to the Linnean Society. By its means, I have now succeeded in checking certainly some six minimum-maximum periods in my seismic table before the date of actual instrumental observation, and, as a fact, Köppen indicates one cycle, 1333 to 1336, far back in time when seismic records are confined to the area of the Old World alone, and I have my doubts whether anyone then really knew the existence of sun spots at all. Other checks are to be found in the deviations of the compass and in the sudden appearance of the Aurora Borealis. And even should the intrinsic value of these last records be not great on the whole, the surprise of a fine Aurora in the south of England—as, for example, those magnificent crimson flashes which broke over London on the nights of the 24th and 25th of October, 1870—could never be disregarded as truly intimating the epoch of a maximum of sun spots.

Lastly, as all would be discoverers, I often ask myself whether a sun spot table, constructed on my plan, has been ever previously attempted. I cannot, myself, answer this question, but I find indications of the line of research are extant in Prof. Karl Fuch's "Die Vulkanischen Erscheinungen der Erde" for 1865, and in an article on the earthquake and volcanic tremors in Brazil, by M. Poëy, a writer who has done much to clear up the difficulties of connecting natural phenomena with the sun spots.

ANALYSES OF BOOKS.

Cameos from the Silver Land, or the Experiences of a Young Naturalist in the Argentine Republic. By Ernest William White, F.Z.S. In Two Vols., Vol. I. London: Van Voorst.

Every one must admit that the La Plata territory, now generally called the Argentine Republic, is, practically speaking, an unexplored region. Its flora, its fauna, its climatology, and its geological and mineralogical details are almost a sealed book, which, when opened, will be well worth reading. One reservation must indeed be made: the old Spanish government of this vast and important region is known to have made a careful survey of its mineral wealth. Of this important document a single copy only is known to exist, and it is unfortunately in the hands of a person who refuses to allow its publication. A country so extensive, and so rich in unrecorded objects of interest, would furnish admirable scope for the labours and researches of a Wallace, a Belt, or a Bates, and we therefore opened the volume before us with impatience. Our hopes, based as they were upon the title of the book, have been gratified only in part. The author, though evidently a zoologist and a botanist, and though enjoying ample opportunities for observation, seems to have given his attention more to the manners and customs of the inhabitants, to the state of society in the towns, the places of amusement, the promenades, and the markets, rather than to the fauna and the flora. Turning to the table of contents we read such headings as "Jealousy of Portenos—Naturalisation—Compulsory Military Service—Papeletas—Mixed Races—Manana—Patriotism a Shibboleth—Capacity of Bonaerenses—Alta Metafisica—Physique of Bonaerenses—Padre Pulpero, Hijo Caballero—Love of Parents—Formation of Character—Morale—Smoking—The Ladies—Madame Rachel—Musical Capacity, &c.—we might almost add *usque ad nauseam*. Such subjects have, of course, their interest for many, but they are hardly what we expect to find forming the bulk of the "Experiences of a Young Naturalist." There is, however, matter much more worthy of attention. The Eucalyptus, it appears, has been introduced, and succeeds well, but we find the complaint that it "sterilizes the ground completely." We should like to learn whether a similar result has been observed in other countries, and upon what it depends? Forest trees, as a rule, do not exhaust the soil nearly so much as do field crops. The author comments on the disastrous effects which on the La Plata, as in all semi-tropical countries, are sure to follow the eradication of the woods. Two winds are noticed which seem to render the preservation of the forests an especial necessity: the Pampero, a south-westerly tempest blowing from the Andes with great fury, and sometimes causing the thermometer to fall 20° in five minutes. The Zonda is a northern wind, hot and dry. It blows from the deserts of Atacama, and raises the temperature with wonderful rapidity. The meteorology of the country is evidently, as the author pronounces it, a very difficult study.

Mention is made of a spider, *Epeira socialis*, which spins a "beautiful cocoon of orange-coloured silk suitable for working." This material has already found practical application. From the specific name *socialis* we should suspect that this spider is less given to internecine strife than most of its kindred.

The province of Mendoza contains an immense supply of petroleum, of fine quality, so that South America need not long be dependent upon the United States for a supply of this requisite. The province of Salta is rich in the cebil, a species of acacia, whose bark contains 20 per cent. of tannin. Unfortunately it is gathered by the profligate system of stripping the bark only as high as a man can reach, and leaving the trees to die. The natives of Patagonia, whom the author calls " huge macropods," are described as having enormous busts, whilst their lower limbs do not correspond to the bulk of the trunk. The whole plain of the Pampas is said to be " sprinkled thick with fossils," of which, however, no further notice is taken. We should think it possible that a careful observer might meet with important novelties.

A blood-sucking fly, the "Mosca brava" (*Stomoxys calcitrans*), is a great obstacle to the multiplication of horses and cattle in the Gran Chaco. As this species is found in England its range must be very wide. The quebracho wood (*Loxopterygium Lorentzii*) is said to be an excellent timber for sleepers, shipbuilding, &c., lasting twice as long as oak. On page 62 we find a curious passage. Concerning the province Misiones we read:—" The *sensual* delights which arise from hills and mountains, dales, plains, and valleys, forests and meadows, a fruitful soil and a deliciously balmy climate are here presented with a liberal hand." We should scarcely call such delights " sensual."

On page 109 we meet with a general survey of the Argentine fauna as met with in country districts. Among the predominant butterflies the author mentions fritillaries, *Colias Lesbia*, *Callydrias*, *Danaus Archippus*, and *Vanessa Io*, which, like others of its group, is almost cosmopolitan. On the river banks are found more tropical forms, such as *Papilio Thoantides*, *P. Perrhœbus*, *P. Lycophron*, species of *Euryades*, *Heliconia*, *Morpho*, &c. A leaf-cutting ant is very destructive to all vegetation not indigenous. Very offensive is the Pampa Bug (*Conorhinus infes-*

tans), a flat chocolate-coloured wretch which haunts the ceilings of bed-rooms, and lets itself drop upon the sleeper. In the morning it is found on the walls "no longer a flat disc but a globular bloated mass." One of the many species of mosquitoes —not named—gives out a delicious fragrance, especially if crushed. The Museum of Buenos Ayres is said to be richer than any other in "palæologic edentate osteology." The author exclaims, "The gigantic Megatherium, or his ancient brother the Mylodon, with what a derisive smile must they view the efforts of their feeble modern vicar (!) the *Bradypus tridactylus*." The museum is under the direction of the illustrious entomologist Dr. Hermann Burmeister. On the subject of rabies, said to be rare in La Plata, the author says:—"As for the dogs the breed is so inferior as not to subject them ordinarily to a disease so aristocratic, which, like the gout in man, only attacks good blood." The Pariah dogs of India, which can scarcely boast of aristocratic lineage, are by no means free from rabies. On page 239 the author goes out of his way to indulge in an attack on cremation and on sanitary chemists. He makes the curious remark that the "custom was all very well for Pagans with little or no notion of the dignity of the human body." The vexed question as to whether vultures find their prey by sight or scent seems to be decided in favour of the former as far as the Condor is concerned. One of these birds, when hungry, took no notice of a lump of meat wrapped up in a single fold of a newspaper. The author considers that there are two species of Condor, a black and a brown.

The author's style is, according to our taste, not sufficiently quiet for a scientific work. We have already noticed some curious expressions, and might select many more. Thus we read of the "cadenic summit" of a mountain, of "Longobardi centaurs," of "Stygian-laden gulleys," a "liquescent water-pear." An eagle is described as sitting upon a pinnacle "ready to swoop upon any unfortunate stray psittac." We are almost reminded of the Limousin student who, for indulging in "tall talk," was evil-entreated by Pantagruel. We may venture to express the hope that the second volume may be richer in scientific facts and written in plainer language.

On Exercise: an Address Delivered on the Anniversary of the Military Medical Culture Institutions on August 2nd, 1881.* By Emil du Bois Reymond. Berlin: August Hirschwald.

Pooh! a treatise on gymnastics, of importance, perhaps, to acrobats and tumblers! Not so, lessons of grave importance, not merely to the medical profession but to the individual man and woman in whatever position in life, to the sanitary reformer, and to the statesman, unless he be wilfully blind. We say to the sanitary reformer, for the mere absence of zymotic disease is a very little gain if a nation is at the same time sinking more widely and deeply into a state of general debility. Prof. Du Bois Reymond, with all the authority due to his high and well-earned reputation, enforces before a gathering of the physicians and surgeons of the German army the weighty truth that every organ of the animal body must be duly exercised if it is to reach a maximum stage of perfectation, or if it is even to remain in a moderately healthy condition. It may, of course, be asked what need is there for so eminent a man to teach so elementary a lesson? We reply, because, elementary as it may be, this truth is not practically incorporated in our habits of thought, and in our daily lives. The vicious old notion that the ordinary sequence of cause and effect does not extend to man haunts us yet. Further, physical debility has been carefully cultivated at the dictates of superstition. The abolition of the cleanliness and the bodily exercises of classical antiquity, and the introduction of fasting, have enfeebled the human race to an extent difficult to conceive. It is sad to think that to this day, in the south of Europe, personal cleanliness involves the suspicion of a leaning to Mohammedanism. In the feudal ages athletic exercises, indeed, revived, but, as far as England is concerned, they were greatly checked by the advent of Puritanism. In our own time physical culture has to meet two enemies; the industrial organisation of modern society is unwilling to leave us either time or energy for the exercise of any faculty of the system not directly applied to commerce, and seems to fear that if we are physically vigorous we may feel tempted to revert to the military *régime.*

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* Ueber die Uebung. Rede gehalten zur Feier des Stiftungstages der Militair-Aerztlichen Bildungsanstalten.

There is another agency which, so far as the female sex is concerned, militates powerfully against a healthy bodily development. We mean the absurd notion that health, in all its manifestations, is coarse and vulgar, whilst indigestion, nervous debility, and the manifest signs of a phthisical, or a scrofulous tendency, are "interesting," refined, and high-bred! Ignorant nurses, governesses, heads of schools, and even mothers, cherish this eror to an extent perfectly disgusting. It would be hard to enumerate the evils which have been occasioned by the modern corrupted use of the term "delicate." Its original meaning has not the least reference to sickliness or feebleness. Much might be gained if our physicians would cease mis-using the word themselves, and protest against its misuse by others.

Summing up all these considerations we must admit that there is still need for men of standing to plead the cause of a thorough physical training.

But Prof. Du Bois Reymond calls attention to a point usually overlooked by the lay public, by drill masters, teachers of athletics, and even by no small portion of the faculty. The so-called muscular exercises are in reality something more; they are at the same time exercises of the central nervous system, of those portions of the brain and the spinal marrow upon which the action of the muscles of voluntary motion depends. It is by this exercise of the nervous system that the co-ordination of the action of the muscles is taught. Few exertions of strength and skill depend upon the contraction of a single muscle. Even in such a comparatively simple case as a leap a number of muscles must act in due proportion and succession. In default of such co-ordination the force of any, or of all of them, is of little avail.

Nor must the exercise of the senses be forgotten, a matter quite overlooked in our ordinary systems of education. Who thinks of training a child to a nice discrimination of form, colour, texture, hardness, and other properties of objects as they appear to our senses? Nor will this ever be done till words, the "money of fools," are thrust into the second rank whilst things are exalted into the first. Training as distinct from information, method as opposed to doctrine require little aid from books.

Into the author's suggestive reflections on the interaction of heredity and exercise, and on the part played by the latter in phylogeny, space does not allow us to enter.

Coming to the practical portion of his address Prof. Du Bois Reymond compares the two systems of gymnastics, the Swedish and the German, and the athletic sports which in England serve as a means of physical culture. The Swedish system he condemns as suitable merely for medical purposes, where it is needful to maintain or increase the activity of particular groups of muscles. "It can strengthen the muscles, but it does not confer expertness in compound movements." We may, however, well question whether the author is fully acquainted with the latest development of the Swedish system by Dr. Zander, as it may be seen at the medical gymnastic establishment in Soho Square. We were most favourably impressed with its value, not merely in the treatment of certain diseased conditions, both internal and external, but as a means of physical culture for the sedentary population of our towns. The German system includes the use of the dumb-bells (Hanteln). But must it not be admitted as an advantage if the weight of the dumb-bells used could be insensibly increased every few days as the muscles of the tyro become developed? Now the Swedish system enables, *e.g.*, movements performed by the same groups of muscles as the dumb-bell exercise to be rendered progressively more difficult by imperceptible stages. We think that Dr. Zander's institution is well worth an attentive examination. Every anatomist must at least be delighted to note the mechanical skill shown in calling into play the various groups of muscles.

As regards the athletic sports of England, such as rowing, hunting, cricket, foot-ball, &c., Prof. Du Bois Reymond is far from denying their value. He concedes that they lead even more directly than the German gymnastics to the power of executing compound movements. Still, he considers that the selection of exercises to which long experience has led in Germany ensures a greater and more thorough equability of bodily development. Just as a well-trained mathematician is provided with methods for every conceivable problem so the German athlete can easily accommodate himself to every required phase of bodily exertion.

He glances at another advantage of the German system. It requires less space, less expense, fewer outward appliances, and may be pursued everywhere by any given number of pupils of any age or condition, whilst English sports require for the most part large open spaces. The author might have added that though well adapted for country gentlemen, for yeomen, farmers, and for the general population of villages and small towns, they utterly fail to reach the bulk of the dwellers in our great cities. But as the city population is increasing, and the country population is decreasing, it follows that a relatively smaller and smaller portion of the nation partakes of any bodily culture. In the commercial classes physical inferiority is signally manifest. It is painful to reflect that the proposal to submit the boys in our Board Schools to a course of military drill is vehemently opposed by a certain faction. The volunteer movement, which gives a slight modicum of physical training to at least a fraction of our town population has been opposed from the same quarter. At the risk of possible execration we will venture to say that apart from all political considerations, which lie quite outside our competence, compulsory military service would prove an inconceivable boon to this nation. The improvement in the *physique* of the Germans, even within the memory of persons now living, is startling, and must give them an advantage which is far from being confined to military affairs.

Chronicles of the Photographs of Spiritual Beings and Phenomena Invisible to the Material Eye: Interblended with Personal Narrative. By Miss HOUGHTON, Author of "Evenings at Home in Spiritual Séance." London: E. W. Allen.

WE have here a work not easy to criticise. The authoress, who is evidently a sincere believer in what she narrates, teaches us that under certain conditions, if the photograph of a living person is taken in the usual manner, on developing the plate there appear occasionally other forms in addition to that of the sitter. These forms are often recognised as the similitudes of deceased friends or relatives. The conditions of these singular phenomena are not definitely enumerated in Miss Houghton's book. As far as we gather from various passages the presence of a medium is essential, but it does not appear necessary that the sitter should possess mediumistic powers. It is also requisite that the sitter should be in a calm, unruffled frame of mind. Even when these conditions are carefully fulfilled success is by no means uniform, or rather, it is decidedly exceptional. The additional figures appear generally draped in wide, flowing robes, like the white-sheeted ghosts of ancestral tradition, but the head and face, according to the specimens given in illustration, are often clearly and distinctly human, and might admit of recognition. In some cases the entire figure is reproduced with but scanty drapery, and sometimes a trunk has appeared without a head. Persons not endowed with mediumistic power see on such occasions nothing save the sitter and the furniture of the room. We have, then, the hypothesis that objects may exist which reflect only light capable of acting upon a prepared plate, but invisible to the human eye. That there are such rays of light, the so-called ultra-violet rays, is admitted. The human eye is only susceptible to a certain part of the spectrum. The ultra-violet rays, further, are able to set up chemical action of various kinds. But the novelty here involved is the supposition that objects exist which reflect such rays, and such only. We have no right to pronounce, *à priori*, that no such objects are possible. But we are here brought in contact with one of the limits of our perceptions. Whatever does not reflect rays of light which affect our retina is for us simply invisible, and, for anything we can show to the contrary, there *may* be such objects. Questions here naturally arise which can only be decided by varied and prolonged photographic experimentation.

The genuine character of the figures obtained is, of course, liable to be questioned, or rather denied. Having never come in contact with jugglers, or studied their modes of action, we are not entitled to say with authority what is within and what is beyond their power. But a very considerable number of precautions for the prevention or discovery of fraud have been adopted. The cameras have been carefully examined and exchanged for others. Private marks have been put upon glass plates brought to be operated upon lest they should be exchanged for others previously prepared whilst in the dark room. The entire studio has been searched, as we understand, not merely by amateurs but by experienced practical photographers, but the "trick," if trick it be, has not come to light. We read :—"Neither Mr. Hudson nor Mr. Herne knew who we were. Mr. Herne I never saw before. I shut him up in the recess at the back of the studio, and secured the door on the outside, so that he did not—and could not—appear on the scene. Mr. B. Coleman, who was with us, and myself (*i.e.*, Mr. Howitt), took the plates at hap-hazard from a dusty heap of such; and Mr. Coleman went into the dark chamber with the photographer, and took every precaution that no tricks were played there."

Another writer here quoted justly remarks:—"No photographer can counterfeit the portrait of a deceased person unknown to him, and of whom no likeness exists. Yet this is what is done in Mr. Hudson's studio." Mr. Beattie (a retired photographer) maintains that the luminous appearances seen by sensitives as issuing from magnets, crystals, &c., as in Baron Reichenbach's experiments, when condensed, affect prepared plates as energetically as does solar light. As regards the tests proposed Miss Houghton remarks *naively* that "Scientific men are very exacting, and have no kind of compunction as to the labour and fatigue that their fancies may entail." She should remember that they spare no labour or fatigue in testing their own results.

The importance of testing these results to the uttermost cannot be gainsaid. A person may think he sees something non-existent. Several persons may fall into the same delusion. But we hold even the author of the phrase must admit that a photographic plate cannot be swayed by a "DOMINANT IDEA."

Miss Houghton's book is inconveniently arranged. We do not find certain principles distinctly laid down and proved *seriatim* by experimental evidence. The plan of the book is historical with much repetition. Hence prolonged reading is required to sift out the phenomena alleged to have been witnessed from matter of a subjective nature. We trust, however, that we have not misinterpreted the author's views.

Physics of the Earth's Crust. By the Rev. OSMOND FISHER, M.A., F.G.S. London: Macmillan and Co.

WE have here an important work by a valued contributor to the "Journal of Science." The author has undertaken to answer certain problems in physical geology, "negatively, if not positively," by the application of simple mathematical reasoning and quantitative treatment, and the results obtained, though admittedly approximate, are not merely of interest in themselves, but are calculated to draw further attention to the method, which has been here pursued. It must not be supposed, that the questions here raised concern merely the physicist, the astronomer, or the geologist. An attempt has been made by an eminent authority, to fix a maximum limit for the time which has elapsed from the solidification of the earths' surface down to the present day. The results reached, though based upon an imposing array of figures and formulæ, vary from 33 to 300 million years, or in the proportion of 1 : 10! Surely such discrepancies might have suggested reasonable doubts as to the value of the whole investigation. Yet, on the faith of calculations so discordant a kind of flank attack has been made upon the teachings of geology, and to a certain extent upon the doctrine of Organic Evolution. Thus Prof. Tait says :—" Geology, in framing its conclusions, is compelled to take into account the teachings of other sciences. If we feel disposed to give an indefinite amount of time to the evolution of cosmos out of chaos, the student of heat and mechanics comes in and asserts upon the authority of his branch of science, that a limit must be put to the time available for bringing about the present condition of things : he will grant 100 to 300 millions of years as the extreme allowance of time; if geologists cannot be content with this allowance, so much the worse for the geologists, for more they cannot have." Now it may be possible and is indeed probable, that the mutations in organic life have not proceeded at one uniform rate. It may also be possible, that the high tides due to the former closer proximity of the moon (See "Journal of Science," 1882, p. 43) may have effected denudations at a much more rapid rate than is now going on, and consequently that geological changes may have been effected in comparatively short times. Still the majority, both of geologists and biologists feel bound to reject Sir W. Thomson's results, as based upon arbitrary and unproved assumptions. Among these suppositions are :—That the earth, though once fluid is now a solid, cooling by conduction ; that the temperature of the earth's crust increases as we penetrate deeper, but at a gradually decreasing rate ; which, at about 5000 feet below the surface, becomes *nil*. That the molten matter ejected by volcanic action is " derived " from the transformed work of crushing the rocks of the earth's crust, owing to the contraction of its interior through long-sustained cooling.

These assumptions, Mr. Fisher traverses very ably, and, in our opinion, additional weight is due to his arguments, because they are brought forward without any regard to the requirements either of geologists or biologists. In his first chapter, he discusses the experiments which seem to indicate that the rise of temperature on boring deeper into the earth proceeds at a gradually decreasing rate, and points out several circumstances by which the results are rendered doubtful. His conclusion is, that " we know nothing by observation, respecting the law of increase of temperature within the earth, beyond the facts, that near the surface the average rate of increase is 1° F. for between 50 and 60 feet of descent, and that the temperature at greater but unknown depths is very high, sufficient to fuse what, from that very cause, we term igneous rocks."

Sir W. Thomson's assumption of the total solidity of the earth's interior rests upon grounds, none of them decisive, and two of which he has in effect given up. Supposing that the earth is, as a whole, extremely rigid, it does not follow that it is wholly rigid from centre to circumference. If further, the elevations on the earth's surface are due to the contraction of a hot solid globe, cooling by conduction to and radiation from the surface, the average height of the elevations above the datum level can be calculated to a few feet. If we suppose that the temperature near the surface increases at the rate of 1° F. per 51 feet, and that the rocks have been solidified at the temperature of 7000° F. (an extreme supposition), the average height of the elevations from the era of solidification down to the present time would be only between 800 to 900 feet. If we take 4000° F. (the temperature of melting slag) as the more probable point of solidification, the average elevation will be below 200 feet. But even the highest of these assumptions is wide of the truth. The average height of the elevation of the earth's surface above datum level is at the lowest estimate 9500 feet. Consequently, Sir W. Thomson's assumption of a wholly solid earth, fails as leading to results glaringly at issue with facts, and his calculations based upon such assumption may be safely pronounced null and void.

The following remark, though directly connected with the present argument, is also important in reference to the constancy of the distribution of land and water:—"The islands of New Zealand occupy a central position in the aqueous hemisphere, and yet they contain a series of deposits chronologically analogous to those of the northern hemisphere; whence it follows that they must often have been submerged during periods, when there existed, in what is now an extended ocean-land, surfaces from which the materials of their rocks must have been derived. The sinking of river-plains and estuaries, a phenomenon of general occurrence, is also significant. The author observes, what is required to explain such facts is a liquid or at least a plastic substratum for the earth's crust to rest upon. In connection with the supposed permanent position of continents and oceans from the earliest times, Mr. Fisher doubts whether the doctrine is fully proved.* It is suggested that a large portion of the ocean now above the earth's crust may have once been below it, and thus we gain a novel conception of a sense in which the fountains of the abyss may once have been broken up.

Passing over much important matter, we come to the author's examination of Mr. Mallet's explanation of subterranean heat, as manifested in volcanic action, in hot springs, and in the high temperature of deep mines. That heat he considers as "produced locally within the solid shell of our globe by transformation of the mechanical work of compression, or of crushing of portions of that shell, which compressions and crushings are themselves produced by the more rapid contraction by cooling of the hotter material of the nucleus beneath that shell." This theory is of the more importance, because, if we admit the hypothesis of a globe solid throughout, scarcely any other method to account for volcanic phenomena remains. The refutation of Mr. Mallet's theory contributes, therefore, powerfully to overturn the assumption of the earth's solidity, and, in consequence, Sir W. Thomson's limits to the duration of our globe.

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* See Quart. Journal Geolog. Soc., xxxvi., p. 351, and Geol. Mag., Decade II., vol. vi., p. 385.

The first objection which Mr. Fisher brings forward, and which to us seems fatal, is that volcanic action is of daily occurrence, whilst it is unproven and strongly doubtful that such contractions have been constantly going on within historical times. Further, in Mr. Mallet's statements, there is a serious discrepancy. In the "Philosophical Transactions" he argues that the heat developed from crushing ten volumes of rock would melt about one, whilst in his translation of Palmieri's "Vesuvius" he estimates that the crushing of one cubic foot should melt 3½ cubic feet, or more than 32 times as much as his former conclusion. It may certainly be said, that if this latter value is correct, the cubes of rock upon which he experimented ought to have been melted, which was not the case. There is another absolutely fatal objection. Suppose, taking the lower estimate, that the heat developed in crushing ten cubic miles of rock would be sufficient to fuse one cubic mile, if it could be all concentrated upon that one; it is still altogether unreasonable to suppose that such concentration can take place. As Mr. Fisher puts it:—"Unless the heat got out of crushing any portion of rock is sufficient to fuse that particular portion, none will be fused."

The chemical theory of volcanic action put forth by Davy is now generally abandoned. Were water decomposed in the interior of the earth by contact with the alkaline metals, torrents of hydrogen gas would be given out, and true flame would be a marked feature in every volcanic eruption. It is scarcely necessary to say that such is not the case.

Want of space compels us to bring our survey of this work to an abrupt close. It is one which may be recommended to young geologists and physicists, as not merely instructive but suggestive, and as calculated to lead to a revision of certain accepted theories. The considerations here brought forward, joined to other evidence, may lead judicious inquirers without at all relapsing into the coarse catastrophism of Cuvier, to doubt whether the opposite doctrine of uniformitarianism has not been carried too far.

Violationism; or Sorcery in Science. By Mrs. Algernon Kingsford, M.D. In "Light," for Feb. 4th, 1882.

Our readers will doubtless be perplexed with the term "violationism." To save them the trouble of a vain search in the dictionary, we may at once say, that it is a cant name for experimentation on animals, invented by a leading anti-vivisectionist.

Mrs. Kingsford, who it appears, is one of the female M.D.'s of the present day, has taken it for the title of an ultra-sensational attack upon physiologists, whom, in a very far-fetched manner, she likens to the sorcerers of old. A few such sorcerers, it appears, used occasionally to torment animals in order to propitiate evil spirits. Hence, in the opinion of our worthy doctress, they stand on the same level as our modern vivisectors, from Harvey downwards! This attempted identification of science with sorcery is, we presume, the retort courteous for the comparisons which have been made between spiritualists and necromancers. The good lady waxes very wroth, and gives us a few of the most sensational cases of vivisection she has been able to collect, doubtless willing that her hearers should consider this a fair representation of experiments upon animals. She carefully avoids encountering the fundamental principlewhich we have so often put forward, viz., that if it be justifiable to inflict pain and death upon animals for "sport," for food, for furs, and other products, for personal safety and comfort, and to force them against their will and convenience to serve us, it is at least equally permissible to inflict pain and death in pursuit of knowledge. The person who shrieks against vivisection, and who yet partakes of animal food, wears furs or feathers, employs horses for riding or travelling, &c., may not be a conscious hypocrite, but he is at least guilty of gross inconsistency. We profoundly regret that the "British National Association of Spiritualists" has allowed this lecture to be delivered at one of its regular meetings. By so doing, it has formally declared war against biologists of all grades, making no distinction between those who regard Spiritualism as jugglery and imposture, and those who, to say the least, considered it entitled to a candid hearing, and hoped that some of its claims might be substantiated.

How to Use the Bromides. By George M. Beard, A.M., M.D. (Reprinted from the "Journal of Nervous and Mental Disease," Vol. VIII., No. 3, July, 1881.)

This pamphlet is the substance of a paper read by the author before the American Neurological Association on the medical uses of the metallic bromides. The value of these compounds, especially the sodium bromide for the prevention of sea-sickness, is well known, but the author insists upon the administration of large doses, say of from 30 to 100 grains, if the effect is to be secured. He gives also the caution that when the tendency to sea-sickness appears overcome the doses should not be continued. Sleepiness by day, loss of sensitiveness in the fauces, are, the author finds, indications to discontinue the treatment.

Dr. Beard, in the course of his experiments on the Maine "jumpers," gave large doses of the potassium salt to one of his subjects, but without any beneficial results as far as the jumping was concerned. Concerning this case Dr. Beard makes the following curious remark:—"I did not know how much I gave him, but this I do know that I would never give the same quantity to anyone again under any circumstances."

The Insect Hunter's Companion: Instructions for Collecting Butterflies, Moths, Beetles, Bees, Flies, &c. By the Rev. JOSEPH GREENE, M.A. Third edition, revised and extended. London: W. Swan Sonnenschein and Allen.

WE have here an enlarged and improved edition of a manual which has been found useful by many entomologists. The editor, Mr. A. B. Farn, in his preface, brings forward an argument for the study of insects, which will be intelligible even to the meanest capacity—the fact that many of the deadliest foes to agriculture are to be found among these apparently contemptible creatures. Fully agreeing with him as regards the importance of a thorough knowledge of these enemies, we can scarcely pronounce any economic results "the grandest end" to be sought for in the pursuit of entomology. We should look upon the study of insects as a field where the problems of the origin and distribution of animal life may be attacked with advantage.

The instructions here given for obtaining specimens of insects in their various stages of existence, and for rearing larvæ, &c., are sound and practical. The chief deficiency which we note is that the author takes a too exclusively "British" point of view. Surely, in these days of travelling and emigration, there is no occasion to assume that even the tyro must confine himself to the meagre insect fauna of the United Kingdom. A few methods of baiting for insects might have been advantageously added for the benefit of such insect hunters as may be disposed to try their fortune in where insects are more abundant. Thus, a white cloth spread out in a garden is a great temptation to insects of almost all orders, and a double crop will often be found upon it and below. A hole bored with a large gimblet in the trunk of a tree, so as to set the sap flowing, is a very successful bait, especially in warm climates, and is particularly attractive to high-flying Lepidoptera. The author mentions rotten apples as enticing; he might safely have said "fruits in general," the preference being perhaps due to very stale bananas where they are procurable. Many species will even settle upon any small putrid animal, and also upon recent human excrement, a sad comment upon the refined tastes generally ascribed to butterflies.

The instructions for collecting Coleoptera are from the able pen of our late friend Edward Newman, but as for the "neglected orders," they are, save the Hymenoptera, completely ignored.

On the subject of setting specimens we differ from the author, and prefer the Continental plan to the English, for the following very substantial reason: If the specimens are fixed high on the pins, and with the wings flat, the access of mites and other depredators is very much impeded if not altogether cut off.

The remarks on the question of exchanging specimens are much to the point. Something might, however, have been said on the absurd value attached to "British" specimens as compared with such of the same species captured abroad. We find nothing similar to this whim in any other country. The annoyance which the collector often experiences from the outside public are described in a manner the accuracy of which we can vouch for, though we were never insulted in the manner described by Mr. Newman in his chapter on Coleoptera.

The book may be safely recommended as a manual for young collectors, and will save them much loss of time and disappointment.

CORRESPONDENCE.

*** The Editor does not hold himself responsible for statements of facts or opinions expressed in Correspondence, or in Articles bearing the signature of their respective authors.

"DISUNION IN THE CAMP."

Mr. T. M. Dolan's able letter in our last issue requires a few remarks on our part.

We denied, and we still deny, the existence of a class of persons who would torture animals under pretence of research. We can find no signs of such a class. The Secretary of the Society for the Prevention of Cruelty to Animals, in his evidence before the Commissioners, admitted that he knew of no instances of wanton cruelty. Dr. Simon, in his Address as quoted by our correspondent, speaks of this class as "imaginary." Knowing how unscrupulous and adroit our enemies are in perverting the public utterances of medical and other scientific men, we cannot help feeling that Mr. T. M. Dolan's words will be used as an admission that such persons really exist.

As regards our respective "methods of warfare," we doubt if any kind of language will have an effect upon the leaders of the anti-scientific movement. But if we can expose their sophisms, and show their want of truthfulness and their inconsistency, we may act upon those who have been duped. As far as our memory serves us, the most successful agitations have been characterised by a very liberal use of language much stronger than we have been in the habit of employing. The tactics of the "Anti-Vivisectionists" themselves have mainly consisted in continually "throwing dirt," in the hope that some of it might stick.

Mr. T. M. Dolan holds that a repeal of the Vivisection Act, *in toto*, is, in the present temper of English society, an impossibility. We grant this proposition. But the *present temper* has been produced by agitation,—thanks in great part to the supineness of scientific men,—and by agitation it may be modified. We would, indeed, accept the "Lancet" programme for the time being, but only as a temporary instalment. In the meantime we think exception may be fairly taken to a certain point in the passage from the "Lancet," as quoted by our correspondent ;— "We do claim that skilled experimenters—physiologists, pathologists, and pharmacologists—shall have perfect freedom to conduct experiments on living animals, *where such are necessary to the elucidation of the problems of health, disease, and therapeutics*." We beg to call especial attention to the words we have italicised: they seem to us far too narrow. We doubt if, *e.g.*, they would include the initial experiments of Galvani, the interesting researches of Madame Chauvin, and, generally speaking, all investigations on the causes which may influence the development of species.* Again, why are the words "physiologists, pathologists, and pharmacologists," used instead of the briefer and more comprehensive terms "biologists and chemists"?

We fear that, so long as certificates are necessary, competent men, if they have not the art of pushing themselves into notice, or if they have failed to do homage to some dominant clique, will find themselves excluded. We are glad to learn that Mr. T. M. Dolan does not propose to make a separate peace with the enemy to the exclusion of non-medical biologists, and we beg to tender our apologies for having misunderstood him. This is a point on which we feel the more jealous as we see plainly that it is one of the objects of the anti-vivisectionists to spread discord among men of Science.

We think we may lay claim to some little insight into the question. In 1876, when some of our contemporaries anticipated that the proposed Vivisection Act would satisfy the enemy, we ventured to express a very different opinion ("Journal of Science," 1876, p. 333), and in the same journal for 1878 (p. 651) we recommended the organisation of a Biological Research Defence League as a pressing necessity. Our suggestion was ignored, and the matter has gone from bad to worse. As "*servus servorum Scientiæ*" we are willing to co-operate with everyone in defeating the deplorable attacks made upon research; but so long as we do not organise we are as a scattered mob contending with a fully equipped, and, we must crave permission to say, "a fanatical" army.

THE EDITOR.

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* It is not generally known that to feed an animal on unusual food, to expose it to a moister or drier air, or to a greater or less degree of atmospheric pressure, might possibly be construed as a "painful experiment," and subject the experimentalist to heavy penalties.

TIDAL THEORY OF GEOLOGICAL DENUDATION.

To the Editor of the Journal of Science.

Sir,—Some interest has lately been created by ingenious speculations regarding the *Moon's action* on the waters of the Earth in past ages, and especially in the creation of geological changes on the surface.

The theory proposes to establish *gigantic tides* in the terrestrial oceans, upheaved by a closer approximation of the Moon, in its orbit, to the Earth, thus increasing its attractive power.

It is believed there would be created a tremendous force of *current* acting as a powerful denuding agent on the superficial formations exposed to its action.

I am inclined to think that some illusion gilds this *attractive idea*, which looks well on paper to the physicist, but can hardly be so confidently accepted by the geologist.

In the first place, the moon's action creates *no currents* in the open sea, the open tide being merely a temporary elevation of the sea-level at points where the moon is passing across its surface, and of course it can create no tides on the dry land, where there is no water. The water in the wave of oscillation up and down does *not follow* the moon at all, but, as soon as the moon has passed that spot, sinks down again.

The tidal wave flows and ebbs in enclosed channels, and seas do not denude the bounding lands into hills and valleys, but level them flat into *sand-banks* and mud-flats.

The rise and fall of 648 feet of the tides would be impracticable to measure, as they could only take place in the open ocean in sufficient depth of water, and would be impossible to realise in our narrow and shallow seas.

In the case of tidal waves of oscillation there is but little analogy with *storm waves*, as the forces elevating the tidal are perpendicular to the surface of the sea, whereas in the latter they are horizontal. The impact of their *momenta* would correspond in direction, the tidal one taking a perpendicular line with lateral offset, and the storm one taking a horizontal direction with perpendicular subsidence.

In the open ocean, if it could be gauged, a tidal rise and fall of 648 feet would take place *gently and gradually*, and slowly, and round the coasts the tidal flow and ebb would only be as high as the *depth* of water there would permit. A wave of water cannot be conceived to travel over land like a gale or *dust storm*, as it would collapse at once when brought into shallows of its own depth from the open sea.

Most of the *denudation* we see on dry land has not been effected by the sea, but by fresh waters in some form, as ice and snow were once more abundantly formed, or else instead there were violent storms, and rains occurring more frequently. The denuding *action of the tides* of our time is very mild indeed compared with that of deluges of rains in the interior of a continent, making rivers, and scooping out valleys.—I am, &c.,

FESTINA LENTE.

MAN: ADAM.

To the Editor of the Journal of Science.

SIR,—In Colenso's great work, the "Examination of the Pentateuch" (People's Edition, § 1052), after quoting from Prof. Owen's Address in Leeds, 1858 (wherein he shows the localisation of certain species from geological ages), Colenso proceeds to apply this to man "from the first differing as species. In that case it would be no longer necessary to believe that the Bushman, Australian Savage, and Andaman Islander are only *degraded* descendants of Adam or Noah, and that European, Chinese, Negro, and North-American Indian are all derived from one pair of ancestors." Then, like Gautama's dewdrop, he slips into his ocean of Geology—perhaps carried to an extreme sometimes.

Surely, in this age of evolutionists, it is more agreeable to the mind to conceive mankind as derived from one common ancestor? The simplest explanation is most acceptable. Is not the very diversity that troubles some of us the key to the truth? It must have been hinted ere now that the different races of men are not "degraded descendants" of the first human pair, but rather evolutions from them; the first fossil head we may find being immeasurably superior to our Adam. Why are not the human race ranked. like other animals, in order of evolution? Is it not evident? The lowest *do* "go to the wall"—we have but to find the connecting-links. The absurdity of Bible chronology has long been exploded, but the prejudice still lingers, and to fix Adam's appearance is simply idiotic. It would probably be a hard feat to draw the line between the highest animal and first man. I see in this the opportunity for language to have developed itself *after* the first man, making this "gift" easier to understand in the broad distinction of animal and man. The question rests only with the geologist, the anthropologist, and the physiologist.—I am, &c.,

D. Y. C.

Ilkley, Leeds.

THE UNFITNESS OF THINGS.

To the Editor of the Journal of Science.

Sir,—Mr. W. Sowerby, writing in the "Journal of the Society of Arts," gives some amusing instances of the manner in which the harmonies of Nature are distorted by artists. Thus a water-plant (*Nelumbium*) is made to twirl and twine over trellis-work like a convolvulus, and a group of Bengal tigers are represented crouching at the foot of an Australian gum-tree. But we may see errors as palpable in the grouping of organic forms even in the British Museum. Not far from the cabinets containing the Hewitson collection of butterflies there may be seen, under a bell-glass, a group of birds mostly—if not all—neo-tropical, and accompanied by insects from the same region; but amidst the latter are placed some purely Oriental forms, such as *Sagra* and *Chrysochroa!* Surely a national museum should not mis-teach animal geography!—I am, &c.,

Scrutator.

NOTES.

An Amusing Instance of Journalistic Inconsistency.—One of the fiercest opponents of experimental science among the lay journals is the " Echo," a cheap evening paper, one of the fixed beliefs of which, to judge from the nature of its articles on scientific questions, is that the " Anti " view is the one most worthy of support. Hence it is a constant occurrence to find its pages ornamented with reports of meetings addressed by anti-vaccinators, anti-vivisectors, *et hoc genus omne*, while its readers are not unfrequently treated to editorials even penned in the same amiable service. It is therefore with a feeling of wondering surprise we find the " Echo" devoting nearly a third of a column to a jubilant description of the benefits to mankind produced through Pasteur's inoculation experiments on sheep and other animals. Can it be that the editor of the " Echo " has forgotten the mode of inquiry by which those results were obtained ? or is it that he has become convinced of the absurdity of antagonism to progress, and is resolved to sever the connection existing between himself and the party that employs his paper as a means of promulgating " Anti " views ? It should be said, however, that the " Echo " has for long consistently denounced the torture of animals under the excuse of " sport," and we are glad to welcome the appearance of a determination on its part now to uphold the legitimacy of vivisection, or rather the experiments on living animals, as it undoubtedly does, indirectly, by accepting the value of Pasteur's discoveries.—*Medical Press and Circular.*

(We must not forget that inconsistency lies at the very root of the Anti-vivisection Movement.)

The " Moniteur Scientifique Quesneville " gives some curious statements of a Parisian *ravageur* concerning human bodies floating in the river :—" I always know beforehand if it is a man or a woman. If the body has the face upwards it is a woman ; if it floats on its belly, with the nose in the water, it is a man. I have remarked that a man who has been thrown into the water after being assassinated reappears on the surface much earlier than one who has fallen in by accident, or has drowned himself. The time the body remains beneath shows whether it is a case of suicide or of murder. Fishes avoid any particularly offensive discharge of matter from the mouth of the sewer, and hide themselves among the weeds till the nuisance has passed."

It would appear from " Light " that Mrs. Kingsford, M.D., who has lately made herself conspicuous as an anti-vivisectionist writer, is a believer in metempsychosis, and suggests that man-eating tigers may be animated by the spirits of deceased cruel men, for ought we know, vivisectors!

The "Lancet" combats the fashionable view that fog is a function of smoke, which gets worse as the quantity of fuel consumed in the metropolitan area increases. It maintains that the fogs in the "thirties and forties" were as bad as those at the present day, if not worse. Friends of ours who recollect London as it was 40 or 50 years ago take the same view.

A correspondent of "La Nature," a native of Guadeloupe, confirms, from personal observation, the report that the males of *Dynastes Hercules* seize small branches of trees between their enormous "horns," and then whirl round and round till the twig is amputated. No one seems to know the exact object of the process, though it may be to set the sap flowing, which numerous insects consume eagerly.

In the Gardens of the Society of Acclimatisation at Paris there are at present two male hybrids, one between a Houdan cock and a Guinea hen, and the other between a Cochin China cock and a Turkey hen. Their morose and unsociable disposition has rendered it impossible to ascertain whether they are capable of reproduction.

Mr. H. H. Howorth ("Geological Magazine,") adduces further evidences of an extensive post-glacial flood, accompanied probably with volcanic action.

Prof. O. C. Marsh ("Geological Magazine,") gives a new arrangement of the Dinosaurians, which he views as a sub-class and divides into five orders, the Sauropoda, Stagosauria, Ornithopoda, Theropoda, and Hallopoda.

"Light" gives a very curious account of a "haunted house." One of the most remarkable phenomena recorded is, that a flame of a gas-burner, placed opposite the foot of the bed occupied by the observer, without diminishing in size, gave out for some time an unusually small quantity of light.

W. H. Edwards ("American Naturalist,") has observed, that male butterflies of the species *Heliconia charitonia*, assemble to keep watch over female pupæ of their own species.

The same author, in refutation of a statement by Mr. Scudder, shows that the females of *Argynnis myrina* have fully developed eggs when they emerge from the chrysalis.

The editors of the "American Naturalist," in reviewing Mr. J. G. Murphy's "Habit and Intelligence," rightly—in our opinion—attribute to the lower animals the power of invention.

Mr. Dieckmann ("American Naturalist") states that tigers are plentiful throughout Siberia, where they remain through the winter. They are said to be larger than the Himalayan specimens, and to have hair five inches in length.

Mr. W. B. Cooper ("American Naturalist,") raises the question, whether the human skull is becoming thinner?

The sparrow-plague in Australia and in America, suggests that the introduction of animal species into a country should no longer be left to the indiscretion of individuals.

Mr. C. V. Riley (American Association for the Advancement of Science, Cincinnati Meeting) argues from [the appearance of noxious insects, that animals may, and in fact do, change their habits and diet suddenly.

Mr. J. J. Weir ("Entomologist") calls attention to the many cases in which the Lepidoptera of the Outer Hebrides differ from the normal colouration of their species, and assume the grey tone of the prevailing gneiss rocks.

Mr. F. J. O'Farrel, of Dublin, a pupil of Professor Galloway, has effected a great improvement in the isolation of glycerine from spent soap lyes.

It is reported that the vacant Chair of Natural History at Edinburgh will be conferred upon Prof. Ray Lankester.

Among the prizes proposed by the Academy of Sciences for 1883 is one for researches on the histological development of insects during their metamorphoses.

About the end of October last a very abundant shower of gossamer took place at Milwaukee.

The "Medical Press and Circular" gives an interesting account of the performances of the Howling Dervishes at Constantinople. The writer notes the connection of sensational religious displays with sexual excitement.

Professor Morris ("Science") strongly insists on the agnostic character of Mr. Herbert Spencer's extra-scientific philosophy.

M. Feye, of Detmold, finds that during three years the lightning struck annually 25·7 oaks, 4·7 beeches, 1·3 other large-leaved trees, and 11·3 conifers. It does not appear what were the relative proportions of the kinds of trees in question.

Prof. Naumann suggests, that the striæ in rocks generally attributed to glacier action may in some cases be due to the action of grains of sand and small pebbles driven by violent winds.

According to "Petermann's Geograph. Mittheilungen," the results of last year's arctic expeditions are disappointing. It is proved that the coast of Wrangel-Land will not form a good base for further progress northwards.

A. Woeikoff ("*Zeitschrift für Erdkunde*,") contends that general glaciation, from the Pole to about 45° lat., is not admissible. If there is sufficient sea it will not freeze, and in large continental surfaces the climate is too dry for glaciers.

The "Comptes Rendus" of last month announces the death of the illustrious French botanist G. Devaisne. The deceased entered the service of the Jardin des Plantes at the age of seventeen, as a working gardener. He died a Professor at the Museum, a member of the Academy of Sciences—of which he was at one time President—and a Fellow of the Royal Society.

M. Harting, of the University of Utrecht ("Comptes Rendus") made some years ago many "mesmeric" experiments upon fowls, pigeons, rabbits, frogs, &c. If the experiments were several times repeated upon the same animal its nervous system was much shaken. Six hens which had been thus treated were seized with hemiplegia and died successively. Hence, the Professor gives a caution as to mesmerising human subjects. (We suppose that in England, Prof. Harting would be amenable to the Anti-vivisection Act.

M. E. Renan shows that the term "anti-cyclone" is not justly applicable to such weather as has been lately experienced in Western Europe. One of these phenomena is not the other reversed: they belong to different orders.

M. Dareste has presented to the Academy of Sciences a memoir on the part played by the amnion in the production of monstrosities. His researches show that a great number of monstrosities result from the partial compression of the body of the embryo, the agent of such compression being the amnion arrested in its development. This compression only occasions teratological results when it is exerted early.

Mr. C. E. de Rance ("Geological Magazine") points out that the position of our ancient villages, and the directions in which our towns have extended, have been determined by the occurrence of springs.

Mr. C. E. Varley, the eminent physicist, has patented an improved divining rod for ascertaining the presence of metallic veins underground.

The "Lancet" says women are not fitted for the calling of Pharmaceutists, because "*they will* talk," and further, "there is in the mind of woman an inherent disability for work of any kind which requires concentration of thought and mental isolation. It is not that she will not, she *cannot*, attend to the business in hand so exclusively as it is necessary the practical pharmaceutist should attend, if his duties are to be discharged with credit to himself and safety to the customers."

Anti-vivisectionists deplore the existence of biologists who are not physicians as a modern innovation. A better acquaintance with the history of Science would show them that the early physicians had little to do with the development of biology, and that the early biologists did not much concern themselves with medicine.

Mr. W. E. Coleman ("Kansas Review of Science") shows that the true destroyer of the Alexandrian Library was not the Caliph Omar, but the fanatical Bishop Theophilus, A.D. 390.

Prof. Trowbridge ("Kansas City Review of Science"), in an able plea for museums of Natural History, curiously says "as the question of Evolution or of Creation is racking the whole scientific and religious world." Are the two mutually exclusive, unless we read "mechanical creation"?

It is generally supposed that all the Arabian philosophers were believers in alchemy. This, according to "Wiedemann's Annalen," is an error. Not only Ibn Khaldun, but At Kiudi and Avicenna and his school proclaim the transmutation of metals impossible, the philosopher's stone a chimera, and the study of alchemy hurtful.

During the discussion which followed the reading of a memoir by Prof. Fairchild (New York Academy of Sciences), on a peculiar coal-like transformation of peat, lately discovered at Scranton, it was mentioned that Dr. Elsberg had—by the combined agency of moisture, heat, and pressure—converted peat into coal.

According to Morselli suicide becomes increasingly common with the growing density of population. Since the beginning of the century it has increased more rapidly than population and than the general mortality. The cases in the United States are 35 per million; Ireland, 16; England, 67; Belgium, 55; Holland, 35; Hanover, 140; Prussian Saxony, 228; Gallicia, 98. Climate is not an important factor.

M. E. Blanchard has laid before the Academy of Sciences a memoir showing the existence, at a comparatively recent date, of a large Austral continent, of which New Zealand is the chief relic. He does not suppose that it was ever connected with Australia. At the conclusion of the paper M. Milne-Edwards thought it necessary to make some remarks quite foreign to the subject.

M. J. M. Charcot ("Comptes Rendus") recognises in "hypnotism" three distinct stages, *i.e.*, the cataleptic state, lethargy, and somnambulism.

ERRATA.—Page 109, line 19 from bottom, for "*etorigo*" read "*et origo*." Page 110, line 14 from bottom, for "Protogoras" read "Protagoras."

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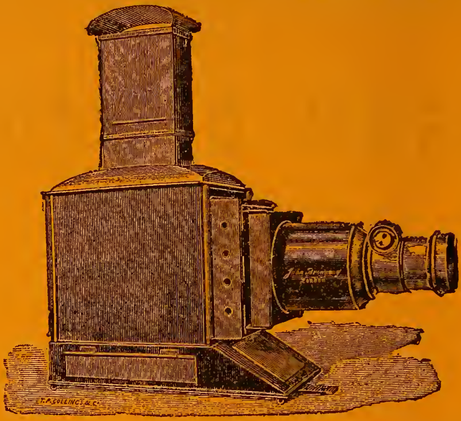

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THE

JOURNAL OF SCIENCE.

APRIL, 1882.

I. ANIMAL AUTOMATISM.*

Communicated by ROBERT LEWINS, M.D.

THIS volume consists of a series of Addresses, Lectures, and Essays, which, as we learn from the short Preface, "have appeared at intervals during the past seven years." It is needless to say that we have here many examples of that profound scientific knowledge, set forth in accurate and pellucid language, which is associated with the name of its author. The welcome task of commendation is indeed so superfluous that, were no flaws discoverable, the book need hardly be reviewed at all, but might be left to make itself appreciated, like the sun, by its own inherent lustre. Happily a few faults afford us an excuse for referring to its many merits; and since the latter will be speedily discovered by all who read it, and taken for granted by all who do not, we may feel ourselves justified in dilating chiefly upon the former.

The two articles which call for special remark are respectively entitled "On the Hypothesis that Animals are Automata, and its History," and "On Sensation, and the Unity of Structure of Sensiferous Organs." In both we find exact statement and luminous exposition, which can scarcely be misunderstood save by the most obtuse or careless reader; yet in both the negative conclusions drawn from positive premises appear illogical and unsatisfactory. Prof. Huxley reminds us of the allegorist who, after relating his story with the utmost verisimilitude, disenchants us at the end by his "Then I awoke, and behold, it was a dream." In the one essay, he traces the progress of an excitation from the peripheral end of the afferent nerve to its termination in the "sensifacient" sensorium; and in the other, shows how the stimulus is reflected through the grey matter of the brain or spinal cord to the efferent nerve. These processes he describes throughout "in terms of matter and motion," leaving no room for the intervention of any spiritual Archæus. Yet at last we are left in doubt whether this creative cerebrum may not after all be a mere phantom, evoked by the Archæus itself.

---

* Science and Culture, and other Essays. By THOMAS HENRY HUXLEY, LL.D., F.R.S. London: Macmillan and Co.

The whole discussion of Descartes's theory of "Animal Automatism" tends to prove that the human organism is a self-acting machine, differing from the lowest forms of life only in its greater complexity. It is simply a watch, supplied with a mechanical contrivance by which it can wind itself up and manufacture other watches. We are told that "modern physiology, aided by pathology, . . . proves, directly, that those states of consciousness which we call sensations are the immediate consequents of a change in the brain excited by the sensory nerves, and, on the well-known effects of injuries, of stimulants, and of narcotics, it bases the conclusion that thought and emotion are, in like manner, the consequents of physical antecedents." Undoubted examples of complicated and seemingly rational reflex action, in man and other animals, are dwelt upon at some length; and in order to examine the train of reasoning which runs through the greater part of this essay, it will here be necessary briefly to recapitulate certain well-worn physiological facts.

If the spinal cord of a human being be divided at any point, those parts of the body supplied with sensory nerves having their origin below the division are absolutely deprived of sensation, but remain capable of apparently purposive motions in response to stimuli. The same holds good of a frog similarly mutilated, but in this case we are able to carry the experiment a step farther. If, without injuring the spinal cord, we remove "the foremost two-thirds of the brain," the animal will jump or walk when irritated, and swim if thrown into the water, but is absolutely devoid of any spontaneity." The inference is "that the impression made upon the sensory nerves of the skin of the frog by the contact with the water into which it is thrown, causes the transmission to the central nervous apparatus of an impulse, which sets going a certain machinery by which all the muscles of swimming are brought into play in due co-ordination." If we remove only the anterior division of the brain lying in front of the optic lobes, the frog is still blind, deaf, and destitute of volition. Yet if the plane on which he is seated be inclined, he will change his position so as to save himself from falling, and, though he cannot see, will yet avoid any object placed between his head and the light, by passing to the right or left of it. "Although the frog, therefore, appears to have no sensation of light, visible objects act through its brain upon the motor mechanism of its body." Consciousness, then, cannot be regarded as the cause of "voluntary" motion, but only as its frequent concomitant. This inference is further supported by the remarkable case of a French sergeant, who, in consequence of a serious injury to the brain, became subject to periodical trances, during which he pursued his usual avocations, but was apparently destitute of spontaneity and sentience. Though he ate, drank, smoked, and even wrote letters, he was totally insensible to pain, or to any physical impressions, with the doubtful exception of impressions of touch. We come naturally to the conclusion that "the argumentation which applies to brutes holds equally good of men; and, therefore, that all states of consciousness in us, as in them, are immediately caused by molecular changes of the brain-substance. . . . The feeling we call volition is not the cause of a voluntary act, but the symbol of that state of the brain which is the immediate cause of that act." It is surely clear that "we have as much reason for regarding the modes of motion of the nervous system as the cause of the state of consciousness, as we have for regarding any event as the cause of another."

In the essay on "Sensation and the Sensiferous Organs" we find facts not less decisive and utterances not less unequivocal. The creative power of our material organisation is fully recognised in a sentence like the following:—"The epithelium may be said to be receptive, the nerve-fibres transmissive, and the sensorium sensifacient," the last word being, as we shall see later, of especial importance. "The sensiferous apparatuses are, as it were, factories, all of which, at the one end, receive raw materials of a similar kind,—namely, modes of motion,—while, at the other, each turns out a special product—the feeling which constitutes the kind of sensation characteristic of it."

But if we here take breath, and hope to be allowed to repose in a logical and consistent Monism, we shall be greatly mistaken. Though the brain is sense-creating; and therefore world-creating; though, "so far as we know, the change in the sensorium is the cause of the sensation," we are now gravely called upon to doubt the existence of matter, and consequently that of the material encephalon, thus admitting all our previous conclusions to be null, void, and absolutely meaningless. We are presented with three hypotheses, corresponding to Animism, Materialism, and Pre-established Harmony, and are told that all stand on the same footing, and that the superiority of the second consists solely in its simplicity and convenience. It has been previously hinted* that no adherents of the third doctrine now exist, and in a former work the first is thus contemptuously dismissed, as unworthy of serious attention and inferior to the most shallow Materialism. "Cabanis may have made use of crude and misleading phraseology when he said that the brain secretes thought as the liver secretes bile; but the conception which that much-abused phrase embodies is, nevertheless, far more consistent with fact than the popular notion that the mind is a metaphysical entity seated in the head, but as independent of the brain as a telegraph operator is of his instrument.† In the concluding article of the present volume, on "The Connection of the Biological Sciences with Medicine," we also find that "the essence of modern, as contrasted with ancient, physiological science, appears . . . to lie in its antagonism to animistic hypotheses and animistic phraseology."

Obviously we have not to join issue with Pre-established Harmony, or with orthodox Dualism, but with what may be denominated Absolute Agnosticism, and which, if logically carried out, would be as fatal to science as it is to philosophy. There can be no doubt that matter, as we know it, "is the hypothetical substance of physical phenomena—the assumption of the existence of which is as pure a piece of metaphysical speculation as is that of the existence of the substance of mind." Yet it may be possible to show that the existence of both is a necessary postulate of valid thought, which can only attain consistency when it reaches the further proposition, that these apparent two are in reality one. In truth, the whole question may be settled by an appeal to Descartes's primary axiom "*Cogito, ergo sum*," which is no mere *petitio principii*, as its critics have erroneously assumed. This will be clear from the following considerations.

A perception, or mental phenomenon, cannot be supposed to possess any energy or power of action. As a mere *appearance* it can obviously only *appear* to act, or to produce any effect. What we regard as a mind in action will—according to Absolute Agnosticism—be only a succession of separate and distinct mental phenomena, not even causally related, since causality is only an inference from observed connection. But if so, there can be no such thing as the development of a conclusion from premises, and consequently a logical chain of reasoning will be impossible. Now when a "heap or collection of different perceptions"* examines itself, and finds its supposed substance in all probability non-existent, its arguments are either valid or fallacious. If valid the "heap" has a more than phenomenal existence, and the arguments again fall to the ground. Universal scepticism thus places itself in the same dilemma as Epimenides the Cretan, when he asserted that all the Cretans were liars. This applies not to Hume's philosophy, but to popular misconceptions of his true meaning, which is clearly stated in the following passage :—"Thus the sceptic still continues to reason and believe, even though he asserts that he cannot defend his reason by reason ; and by the same rule he must assent to the principle concerning the existence of body,† though he cannot pretend, by any arguments of philosophy, to maintain its veracity. . . . We may well ask, *What causes us to believe in the existence of body?* but it is in vain to ask *Whether there be body or not?* That is a point which we must take for granted in all our reasonings."‡ Hume's real aim was the demonstration that the basis of reason cannot be derived from reason itself. Certain primary assumptions, not philosophically proved, but justified by intuition and experience, are necessities alike of abstract thought and practical conduct. This does not, of course, apply to hypotheses such as Animism, which can be contested by non-suicidal arguments.

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* Page 234.

† Life of Hume, p. 80.

The existence of a material proplasm of mind is implied by Prof. Huxley when he describes the sensorium as "sensifacient," and consequently prior to the sensations which it creates. Yet, though we are forced to believe in "mind-stuff," does this in any way prove the reality of matter? Since "our sensations, our pleasures, our pains, and the relation of these, make up the sum total of the elements of positive, unquestionable knowledge," may not the seemingly creative brain be itself a creation of the mind? No man can examine and experiment upon his own cerebral organ ;

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* HUME's Treatise of Human Nature, Book I., Part IV., Section 2.

† The word "body" is here used as synonymous with *substance*, either of mind or matter.

‡ *Ibid.*

and the mass of grey and white matter which the brain of another presents to him, is, like the rest of the "external world," a mere subjective phenomenon. But each individual is justified by analogy in assuming the existence of other individuals, who manifest their thoughts and sensations in the same way in which he manifests his own. The physiologist or physician is therefore practically an observer of two sets of phenomena—those which belong to the physical frame of the patient, and those which belong to his mental constitution. The latter kind of observation is, of course, only mediately possible ; but the facts of which it takes note may be sufficiently interpreted by the experience and self-knowledge of the investigator. He will discover that all changes in the latter class are preceded by certain definite changes in the former, and will at length arrive at the conclusion that the mind "is really a system of effects, the causes of which are to be sought in antecedent changes of the matter of the brain." * He will next remember that, as shown above, every thinker is forced to postulate the reality of "mind-stuff,"—that is, of a matrix which generates the phenomena of sensation and thought. If not misled by genius, he will see the necessity of ascribing the invariably preceding phenomena of matter and motion to the same creative proplasm, since he is not entitled to assume the existence of any other. Since these latter phenomena are by common consent called material, he is justified in assigning to the proplasm of mind the familiar name of matter. Thus we may say of the brain, "*Cogitat, ergo est.*"

This monistic view is preferable, not merely from its convenience as a "working hypothesis," but because it contents itself with asserting the being of that matrix whose non-being is unthinkable, and declines to take any note of an "immaterial substance," for the existence of which, as Prof. Huxley admits, not a particle of demonstrative evidence can be offered. The attitude of a Materialist towards the "*anima*" is that of every modern astronomer towards those planetary genii, or "ruling spirits," which were finally dis-established by Kepler from their crystal spheres. The existence of such beings "cannot possibly be disproved," and no reason can be given for disbelief in them, save their total superfluity.

Let us, then, assume our material proplasm as the *vera causa* of mental and physical phenomena, and see how this theory agrees with recognised facts. In the first place, we find that it is the very basis of medical science, and that every ordinary practitioner who has ever attended a dyspeptic or hypochondriacal patient knows that he can only minister to the mind by ministering to the body. If he were treating simply a phantasmal apparition, there could be no result, save in his own inner consciousness; but since his remedies do produce a result in the inner consciousness of his patient, it is clear that the physical frame upon which they have acted, so far from being unreal, is the only reality with which he is practically concerned.

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* Life of Hume, p. 78.

The effects of the food which is daily transubstantiated by the incarnating digestive organs,* and the atrophy of mind and body which follow prolonged abstinence, prove alike the real existence of the material universe and its complete homogeneity with our own being.

Prof. Huxley states that he is "utterly incapable of conceiving the existence of matter, if there is no mind in which to picture that existence." Here, as elsewhere, he confounds material phenomena, which cannot exist without a percipient mind, with matter itself. Unless his views have recently undergone a marvellous change, he holds that the earth was in being very long before the appearance of any sentient organism. Will he now maintain that this æonial existence depended upon a picture formed in some mind, Supreme or otherwise? In his work on "Man's Place in Nature" he expressly asserts his conviction that mind is developed from matter, and that "even the highest faculties of feeling and of intellect begin to germinate in lower forms of life." According to his present theory, nothing whatever could have existed previously to this germination—not mind, since it was as yet unborn; not matter, since there was no mind in which it could be pictured. In fact there could have been no "lower forms of life," and therefore no germination!

The existence of matter may now be regarded as a theoretical and practical necessity, and the only question which remains is this—Can a separable spiritual essence be considered absolutely superfluous, or must the "dead matter" of the universe be inspired with energy from some external source before it can fashion itself into living and sentient organisms? Let us turn for information to Prof. Huxley himself. "If," he says, "there is any truth in the received doctrines of physics, that contrast between living and inert matter, on which Bichat lays so much stress, does not exist. In Nature nothing is at rest, nothing is amorphous; the simplest particle of that which men in their blindness are pleased to call 'brute matter' is a vast aggregate of molecular mechanisms performing complicated movements of immense rapidity, and sensitively adjusting themselves to every change in the surrounding world. Living matter differs from other matter in degree, and not in kind; the microcosm repeats the macrocosm; and one chain of causation connects the nebulous original of suns and planetary systems with the protoplasmic foundation of life and organisation." * We have, then, a substance to which all known manifestations of cosmic and vital energy can be traced, and beyond which we can never penetrate. No independent principle of life is needed to vivify what is already vital; no basis of mind is necessary save that cerebral tissue which originates and conditions the facts of consciousness. We may say, in the pregnant words quoted by our author from Descartes, "So far as these [functions of mind and body] are concerned, it is not necessary to conceive any other vegetative or sensitive soul, nor any other principle of motion or of life, than the blood and the spirits agitated by the fire which burns continually in the heart, and which is nowise essentially different from all the fires which exist in inanimate bodies." The minor physiological inaccuracies of this sentence in no way detract from its fundamental truth.

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* Digestion (concoction), a pre-scientific—indeed anti-scientific—term, is, in correct phraseology, now superseded by the term assimilation, *i.e.*, the process of *asselfing*, or incorporating with Self objects of Not Self, thus indicating the essential consubstantiality of subject and object.—R. L.

In taking leave of this very instructive volume, we may, in the same breath, justify its author and the "common-sense philosopher" whom he so sternly rebukes. Far from cavilling at Reid's maxim, that "it is genius, and not the want of it, that adulterates philosophy, and fills it with error and false theory," we gladly welcome it, as accounting, in a pleasing and rational matter, for certain deviations from sound sense and logical reasoning which we discover even in the writings of so distinguished a *savant* as Professor Huxley.

C. N.

Note.—As further evidence that the philosophic and scientific Materialism advocated in the above article is ratified by contemporary Medicine, let me be allowed to quote the following extract from a "Defence of Vivisection," by Sir William W. Gull, in the current (February) number of the "Nineteenth Century." At page 457 that high practical authority writes—" Until to-day the theory that the living quality in us was due to a mysterious vital force [*i.e.*, *immaterial spirit or principle*], out of the reach of Science, preoccupied the mind, and stood in the way of observation and experiment. But now it has become the immovable standpoint of physiology that a living creature is dependent for all its bodily functions upon the forces of inorganic matter; in other words, that our corporeal life is but the operation of material atoms and material forces within the reach of experimental enquiry." Comment upon this authoritative negation of spiritual agency in vital action seems superfluous.—R. L.

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* Science and Culture, p. 347.

I. THE "SPECIES" WAR REOPENED.*

NOW that the doctrine of Evolution is generally accepted by competent authorities, and now men of Science are settling undisturbed to the serious task of examining in detail how existing forms have arisen, they will doubtless feel no little surprise at a reopening of the original question. Yet this is actually done in the two treatises before us, though it must be admitted in a very different manner, and with very different degrees of ability.

Mr. Newton Crosland writes in "Light," the accredited organ of the Spiritualists. We regret to perceive that this body seem to be entering upon a career of aggressive war against biological science. A few weeks ago there appeared in the same paper, under the *ad captandum* title "Violationism, or Sorcery in Science," a hysterical onslaught on physiological experimentation, cunningly enough designed to arouse the fanaticism of the vulgar. Now we have an attack upon "Darwinism," in which the author demonstrates at least two things—his intense animus against the Evolutionist doctrine, and his utter incapacity to deal with the question. In proof of this charge we need merely quote the following sentence:—"Darwinism professes to expound some of the most important difficulties and aspects of Creation by a theory of Evolution based upon three (!) principles, termed—1, the struggle for existence; 2, natural selection;

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* Permanence and Evolution: an Inquiry into the supposed Mutability of Animal Types, by S. E. Bouverie-Pusey. London: Kegan Paul, Trench, and Co.
Darwinism, by Newton Crosland.—"Light," for February 25th, 1882.

and 3, the survival of the fittest." To find one agency thus classified and discussed as three may well astonish the reader.

Mr. Crosland writes: "In a recent number of 'Knowledge'—a publication so named on the *lucus a non lucendo* principle, I presume—there is a review of a book by Sir E. Beckett on this subject of Darwinism, in which the author very satisfactorily shows that the spider must have made its web complete from the first, otherwise it would be useless." If Sir E. Beckett and Mr. Newton Crosland had been in the habit of observing spiders they would have seen that even very rudimentary webs are of great service. Those species which leap upon their prey secure themselves by means of a single line, so that if they miss their spring they are in no danger of falling, We must further remind this writer and Mr. Mortimer Collins, from whom he borrows a flippant motto, that Evolutionism and Positivism are not identical. Comte, the founder of the latter doctrine, was a firm believer in the permanence of organic species. Here, however, we must dismiss Mr. Crosland. If he wishes to discuss this subject we would recommend him to devote, say, ten years to the serious study of animal or vegetable life, not in books, but in the museum, in the laboratory, and, above all, in the fields and woods. At present he is rich chiefly in that attribute against which the gods themselves are powerless.

Mr. Bouverie-Pusey is a writer of a very different class. He has evidently given the question prolonged and close attention. He does not invoke the *odium theologicum*. We find in his work no assumption of the perfection of Nature, no outburst of horror at the suggestion of man's possible blood-relationship to apes, no assertion of mechanical creation,—nothing, in fact, of the Old School of Natural History or of the stock-in-trade of anti-Darwinian controversialists. His aim is not so much to set aside Evolutionism as to pronounce its formal acceptance premature. He is for suspending judgment. As to how species were originally produced "we must be content to own that we know nothing." Again, in the last sentence of the book, we read —"All these considerations impress upon us more and more that the origin of organic types is at present, and till we have some new knowledge enabling us to attack the problem in quite a different manner, an insoluble mystery." Here, then, we have a conclusion certainly free from rashness and presumption, and we cannot refuse our tribute of respect to a writer who, in an age of over-hasty speculation, evinces such judicial caution.

The first point we notice is that Mr. Pusey, whilst maintaining the permanence of types, rejects the notion of species. He writes :—" Whatever else becomes of Darwin's labours, the conventional notion of species which includes together all human beings, and at the same time separates the wolf from the jackal, can never be built up again." He contends that the conventional idea of species is the " antipodes of a clear idea, combining as it does the notions of origin from one stock, real or possible ; existence in a wild state, even in separate areas ; fertile reproduction *inter se*, breeding together naturally without human interference, and a certain undetermined degree of likeness." There is no subject indeed on which naturalists differ more hopelessly than on the number of species of a certain group which exist in some given area. If we ask a number of botanists how many native species of roses occur in Britain, we shall receive very discordant answers. Turn to the entomologists, and question them as to the species of true dung-beetles (*Geotrupes*) found in this country : some will reply two only, some three, some nine, besides a variety or two ! Hence we have among naturalists two parties, known by the inelegant names of " lumpers " and " splitters." The former are accused of overlooking weighty distinctions, whilst the latter are said to invent differences where none exist. The ordinary conclusion drawn from this difficulty, or rather impossibility, of defining strictly what should constitute a species, is that the forms of organic beings flow into each other continuously, and that hence the transmutation of species is the more probable. Mr. Pusey draws a different inference. We all know the weight laid by French anti-evolutionist writers upon the so-called " Egyptian " argument for the permanence of species,—the fact, or alleged fact, that the mummies and skeletons of certain domestic animals found in the catacombs differ not appreciably in structure from specimens of the same kind living in the present day. We know, further, the reply that this argument, if anything at all, proves too much, since, according to similar Egyptian evidence, races of mankind and breeds of cattle were as mutually distinct as they are in this nineteenth century. To the Old School of Natural History, who—whilst maintaining the permanence and distinct origin of species—consider that races, breeds, and strains have been formed by what is at bottom a process of Evolution, this reply is fatal. But Mr. Pusey pronounces the variety, the race, the strain, also permanent. He finds " no difficulty in believing that at the first formation of animals there existed, independently, not only what we happen to call distinct species, but also sub-breeds and strains still more faintly characterised." This is in some respects a novel departure in natural history, exactly antipodal to the Evolutionist supposition that all animals are ultimately descended from one common stock. Anti-Darwinians contend, *con strepitu*, that we can produce no evidence of a gorilla or a mias developing into a man. But neither have we on record any well-authenticated instance of a white man or woman being born from any pure negro stock, or *vice versa*. So that Mr. Pusey cannot be confuted by direct evidence. The believers in the independent origin of species who assume that each is the issue of one primordial pair cannot confute him, for they are incapable of accounting for the origin of varieties and races without making dangerous admissions.

To this doctrine of permanence it is replied by Evolutionists that the evidence in its support is purely negative. No one, perhaps, has seen a novel animal type developed from one pre-existing. But no one has seen a new type originate in any other way. Yet that different series of forms have successively appeared upon the earth appears certain. Whence then, and how? The Evolutionist view, however unsupported by direct evidence, seems at any rate more conceivable than the equally unsupported view of independent origin. For whether is more likely, that an existing form should give birth to descendants more or less modified, than that new forms should arise out of the earth or be condensed from the air? We may venture to say that if any five or ten educated and reputedly truthful men were to make affidavit that they had witnessed such an occurrence, they would be simply laughed at, and that by believers in independent origination not less than by evolutionists. Had we the misfortune to witness such an event we should conclude ourselves the victim of an illusion, or else we should be forced to admit that Science was henceforth an impossibility because Nature was without order. And no third alternative can be supposed. Evolution or independent origin; it is Hobson's choice. In what way either is supposed to have been effected does not here come into consideration. Mr. Pusey admits that Evolution is more conceivable than production in any other way. But he seeks to set this admission aside by the following illustration:—"It would seem to the eye of a layman (and with regard to the origin of life we are all laymen) easier to make one salt out of another closely resembling it than out of an acid and a base which do not resemble it at all. Yet we know that the one is possible, and the other supremely impossible. So to a savage it would no doubt seem easier to turn, say, a watch on the Swiss horizontal principle into an English chronometer than to make the last anew out of bare metals; yet in point of fact the Swiss watch, as such, could not be converted, but would have to be entirely reconstructed." This is exceedingly acute, but we think that the analogy here put forward is open to question. We are not all laymen as regards the constitution, mechanical and chemical, of animals. The supposed man who thinks two salts convertible merely from an external similarity is not fairly comparable to the naturalist who, having minutely dissected two animals and analysed their tissues, finds them substantially identical. The supposed salts are not convertible because the one contains some element which the other lacks. Between, say, the horse and the ass there is no such difference, chemical, morphological, or physiological. The Swiss and the English watches, again,—even to the eye of a man who, like ourselves, is totally ignorant of watch-making, contain respectively different structural elements.

The author makes the following suggestion:—"Let us suppose that organised beings are merely chemical products of excessive complexity,—of complexity proportioned to their elevation as organisms,—and whose systematic affinity is dependent on the resemblance between their elements; and that the excessive rarity of their appearance *de novo* on this planet arises from the complexity, and consequent rarity, of the collocations of matter necessary to produce them; this hypothesis, though totally without positive evidence to support it,—and I certainly do not mean to propose or defend it,—is in itself quite as clear and definite, and explains the facts as well, as the hypothesis of Evolution."

The hypothesis here sketched involves abiogenesis, or spontaneous generation, not of minute and relatively simple creatures, but of the largest and most complicated forms of life. How are the various elements necessary to form, *e.g.*, a full-grown ox or a horse, to be brought together in sufficient quantity? How are they to be wrested from the simpler and more stable inorganic compounds in which they are present? and how combined, not merely into such bodies as albumen, but formed into organic tissues? We know of no force, no form of energy, capable of at all approaching this task. If such a force existed we do not see why, acting as it must upon the same elements, it should not yield results always alike. Further, if species are to be produced in this manner, at least two individuals, one of each sex, must appear at the same time and place.

The author more than once seeks to show a close analogy between animals and crystals, and to argue from the one to the other. But the transmutation of metals, or of crystals were it possible, would be a phenomenon of a totally different order from organic Evolution, and the two could throw no light upon each other. No one suggests that the mature animal or plant ever passes into some other type. The followers of Darwin suppose merely that it may produce a progeny varying more or less from itself. Now the crystal has no vital cycle, and is not reproductive. Here, therefore, the comparison breaks down.

Mr. Pusey, in dealing with the palæontological evidence, pronounces it "possible, however unlikely, that some day we may find a true horse contemporary with Orohippus." Be it so: it will be time enough to deal with such a phenomenon when it arises.

The author refers, in passing, to the attempts made by Sir W. Thomson and other physicists to limit the Earth's past duration. When it can be shown that the data upon which their calculations are founded are anything better than arbitrary assumptions, it will be early enough to regard them in any other light than as mathematical exercises.

The theory of "Sexual Selection," as supported by Mr. Grant Allen, is severely but ably criticised. Why, the author asks, are grass-eating Mammalia never green? If animals are attracted by the colour of their food we might expect cattle, sheep, deer, &c., to be predominantly green. "The thing which requires to be accounted for is not simply the presence of bright, but the presence of various different bright colours, arranged often in beautifully different patterns, separately characteristic of different living forms."

Many of the author's strictures on "Natural Selection" are very just. In common with most naturalists of the Evolutionist school, he fully recognises that such selection may preserve types possessing some distinctively advantageous feature, but can originate nothing. He remarks that in the highest, and therefore according to Darwin the latest developed of brutes,—to wit, the anthropoid apes,—"we find considerably lower fertility than in most other animals, and a longer period of infancy compared with the whole life of the creature. So that these high Primates must have lost instead of gaining (as far as the struggle for existence is concerned) in the course of their development out of lower types." It is further urged that the higher animals altogether are inferior to the lower in fecundity, in hardiness, and in earliness of maturity,—in short, in the very points which Natural Selection would have developed. "These characters are of such a nature that they would remain beneficial to the creature under any conceivable change of circumstances." The author even adds, "An hypothesis of retrogression would probably be more consistent with natural selection than one of progress." This view—which by the way has been adopted by an American author—Mr. Pusey considers incompatible with the palæontological and ontological evidence.

From the following passage we must express our dissent *in toto*:—"In one most important part of the animal kingdom, however, a consistent evolutionist will be forced by ontogeny to assume retrogression where progress has hitherto been assumed. I allude to the anthropoid apes whose young are much more like man than the adults are afterwards; and we must therefore suppose, unless we give up the idea hitherto maintained by nearly all Evolutionists, and which is one of the main bulwarks of the development theory, that the growth of the individual pictures in miniature the growth of the race,—we must suppose that these are degenerated from a human or semi-human condition." The facts of the case are thus: the infant mias and the infant man are more like each other than the adults of the two species. As they grow older they are developed in different directions, and consequently diverge from each other—a phenomenon which to us seems strong evidence in favour of Evolution, and of which the study of embryology affords countless instances, species glaringly unlike when mature being with difficulty distinguishable in the early stages of fœtal existence.

In animal geography the author is not always a safe guide. He writes—"But New Zealand is not properly an oceanic island. It was recently connected with Australia. Then why has it no native mammal instead of being full of marsupials?" But though New Zealand was at one time doubtless much more extensive than it now is, the whole character of its Fauna and Flora negatives the supposition that it has been recently connected with Australia. For instance, while Australia abounds in serpents, New Zealand has none. Mr. Pusey says—"Since the time when Darwin wrote that Batrachia were never found in oceanic islands tree-frogs have been identified in the Fiji group. The same [what?] may be said of the land tortoises of the Galapagos. But the most instructive instance in this respect, perhaps, is that of the West Indies. There we have a marked insular fauna, almost no mammals that are indigenous (although cattle and goats have flourished and become feral under European auspices), but an enormous profusion of land-shells, surely as difficult to transport as mammals. It would seem that there must be some cause tending to extinguish mammals on islands after a certain lapse of time, though they do well enough for a short period." Tree-frogs and land-shells, though they possess but limited powers of locomotion, are very liable to be introduced by drift timber, and when once housed in localities such as, *e.g.*, the Antilles, where they have few enemies, they may be expected to multiply not merely in individuals, but in species. To refute the notion of a cause tending to extirpate mammals in islands, we need only look at the Eastern Archipelago. Java and Sumatra do not differ greatly in area from Cuba and Haiti. In climate and productions there is great similarity. Yet Java has ninety species of indigenous mammals. Compare this with Cuba! Yet the probability of extirpation by human agency must be much greater in Java. It has throughout good roads, a more ancient civilisation, a denser population, and a more energetic Government. Surely, then, if in addition to these varied agencies there were some general and unknown cause tending to extinguish mammals on islands, its fauna ought to be at least equally poor with that of Cuba.

We fully agree with Mr. Pusey's advice that we should find out by actual experiment what changes can be produced in a pure strain, and how, and that we should further seek to obtain a "knowledge of the mode of action, if not of the nature of the forces by which the formation and precise arrangement of the several parts of the mechanism of an organism are determined, as well as of those laws under the influence of which one creature, say, is caused to be of one colour, while another—in other respects very closely allied—has a different colour imposed upon its corresponding textures, and so with regard to other characters." At the same time, whilst admitting the necessity of such researches, we must remind Mr. Pusey that work of this kind is being carefully executed by not a few naturalists of merit.

We are very far from considering that every point of the new Natural History has been fully demonstrated. We are only too conscious that with many enquirers zeal has outrun knowledge, and that conjectures have been accepted for established truth. But for this unsatisfactory state of things the best remedy is, we submit, to test the Evolution hypothesis in actual work.

Mr. Pusey's book may be recommended to all naturalists who are desirous of rendering a reason for each and all of their tenets.

III. SCIENCE AND THE SENSE OF BEAUTY.

By J. Munro, C.E.

> "Let knowledge grow from more to more,
> But more of reverence in us dwell;
> That mind and soul, according well,
> May make one music as before."

THE study of pure Science tends in a measure not only to lessen our sense of the beauty of external Nature, but to dispel that reverent spirit in which we should regard each other and the wonderful universe in which we dwell. In the young prime of the world, before the era of positive Science, Nature could not but be viewed with unchecked feelings. She was looked at with the eye of the poet and the artist. Her beautiful forms and colours inspired delight and wonder: the play of her varied energies invoked sympathetic moods and feelings in the soul. Both sentiment and fancy were free. Imagination ran riot at will, and gave birth to Superstition. The flaming sun, the blue air and gorgeous clouds, the resplendent hues of verdure and flowers, the mixed scenery of rocks, woods, and waters, were not only beautiful, but mysterious. They possessed the mystery of a vision, they were the Creator's dream; earth was a Paradise conceived by the Divine imagination. The soul felt the mysterious influences of Nature, who seemed herself to have a soul. The woods and groves were peopled by idyllic beings of celestial purity. Superstition, sprung from awe and reverence, attributed occult effects to supernatural causes. Minds naturally philosophic attempted to account for all things out of their inner consciousness, and propounded systems which show how much poetry entered into their views of Man and Nature. The positive science which did exist was merely empirical—detached links of the chain of observed facts which would in future ages be laboriously forged into great generalisations.

The student of modern Science is led by patient observation and experiment into the details of Nature. He is no longer viewing the great masses of the heavens and endeavouring to solve the riddle of their mysterious motions. He is busy investigating the component particles of their large masses. The discovery of gravitation has silenced the music of the spheres, and the spectroscope has put their ancient divinity to flight. The sun is seen to be a blazing fire of the chemical elements, giving out its central heat to surrounding planets; the stars are more distant suns; the nebulæ are fiery clouds of incandescent gas. All bodies, whether on earth or in the heavens, are known to be compounded of small pieces of matter called atoms. All the atoms of one substance—carbon, oxygen, gold—are alike, and have the same properties wherever found. By close observation and laborious experiment these properties are slowly discovered. When he has made himself master of their secret, the chemist is able to reproduce for himself, in his laboratory, the phenomena of Nature which are due to the combinations and decompositions of these molecules. He can even go farther, and create for himself new substances, crystals, airs, and liquids, never found on the earth, and perhaps existing nowhere else. Such experiments—which are never failing, never capricious, but always yield the same result when the same preparations have been made—impress upon the mind of the scientist the conviction that atoms are endowed with certain inherent properties which never alter in degree or kind. In all the numberless experiments which are constantly being made, there is not a vestige of evidence to show that an ultimate particle has ever perished. On the contrary, the grand results of modern chemistry are built upon the faith that matter is indestructible.

Besides matter itself, the modern student of Science has to deal with the motions of matter. Heat, light, electricity, magnetism, sound, and sensation, are all accompanied by molecular motion; they are all manifestations of energy. Profound research has shown that this motion is never lost; it may change its form, but it is never destroyed, nor can it be created by man. Heat-energy may be transformed into electricity, electricity into magnetism, magnetism into sound or light, and these again into sensation; but the sum of the energy, through all its varied transformations, is known to remain the same. The modern science of physics rests on the belief that energy is indestructible. These two great generalisations are the recent results of our positive Science. In contemplating them the student comes to look upon the fabric of Nature, with all its infinite variety of form and change, as an infinitely complex structure of atoms, built up by energy. He is led to regard the universe as being in incessant motion,—a *living* machine, it is true, but a machine still, and only the more complex because of its life.

The early philosophers of the seventeenth century, and even of the eighteenth, were unacquainted with these important generalisations. Even Newton probably did not divine them. The study of the heavenly bodies, in their dimensions and evolutions, is conducive to grandeur of imagination, and the early astronomers had not yet learned to investigate them in detail by means of the spectroscope. Young, Franklin, and Priestley, conducted their pioneer experiments with a sense of religious reverence. Newton likened himself to a child picking up shells by the sea-shore, while the great ocean of Truth rolled before him. To these men, at least, Nature was still robed in mystery. We have trafficked with her a great deal since those days, and she has become more familiar to our vain minds. By occupying ourselves so much with the little we have learned to understand of her, we are insensible to what is still beyond our knowledge. By classifying the shells in the bay we have lost some respect for the ocean still unexplored.

Yet there is a lofty poetry in the wonderful revelations of Science,—a poetry felt by Newton, Herschel, Faraday, and perhaps by all great discoverers. It is still sometimes felt by the student as he pursues his studies into fresh fields. If, then, we have lost a reverent sense for the marvels we are familiar with, we should rather attribute it to the triteness of our knowledge than to the character of that knowledge in itself.

One of the consequences of a scientific view of life and the phenomena of nature is a certain tendency to Paganism, but without its religion of ideal beauty. According to Science we are subject to the natural laws of our nature and dwelling-place. We live, like the hyssop on the wall, because we are strong enough to withstand the mechanical powers of the universe arrayed against us. Evolution accounts for our existence and maintenance, in the same way as it accounts for the existence of the lower animals. It discovers our immediate origin in the anthropoid apes, from which we are removed by a higher development of similar powers. If we brood too much on this kinship with the brutes, we shall be in danger of losing our subjective sense of the delicacy and grace of life. The beauty of life, for its own sake, will be taken from us, and there will be a tendency to animalism in our thoughts. We shall feel lowered towards the brutes from which it is said we are sprung, and we shall seek to justify a sensuous existence. Young anatomists often suffer from a morbid view of life engendered by their studies. They lose their old reverence for the human body, and the delicate charm of life is marred by the ghastly sights of the dissecting-room. So, in these present days, many a susceptible youth is haunted by the spectre of protoplasm. Even the beauty of human beings is not strong enough to purify his tainted imagination, for it, too, is only a painted protoplasm in his jaundiced sight.

Our free and healthy sense of the beauty of Nature is undoubtedly to some degree sapped by the close study of Science. "Here's confusion to Newton," was the toast of the poet Keats one evening, in company with Haydon and Wordsworth, "because he has taken away the poetry of the rainbow." Newton decomposed the sunbeam into its primitive colours, and led to the explanation by Descartes of the rainbow. The loveliest thing on earth, the bow of promise round which beautiful legends had clustered from immemorial time, was degraded to a mechanical contrivance. A severe shock was from that moment given to our appreciation of its beauty. But such has since been the fate of many beautiful things that once lived entirely in the imagination. Science takes us behind the scenes, which the poet and artist only sit in front of and admire. The enquiring spirit is not content passively to look on, but must investigate the stage machinery. And when we find that we can turn the knowledge we thus gain to a beneficial use, such enquiry becomes a duty and a passion. We are fated to know the causes and processes of things, as well as to enjoy their effect upon our sensibilities. But there is no good reason why knowledge should war with sentiment, if the true function of each is borne in mind and kept in its proper place.

The chief reason why scientific knowledge conflicts with sentiment, and curtails imagination, is that it induces a scientific habit of thought instead of a passive yielding to the enjoyment of beauty and the pleasant reveries it would inspire. Our scientific curiosity is excited, and we find ourselves trying to explain the physical causes of the effect of the impression produced on us. We are like the geologist who was insensible to the beauty of the Apollo Belvedere, because he was examining the texture of the marble. We cannot enjoy to the full the beauty of the rose for thinking of its cellular tissue, and the tender hues of sunset lose their poetic spell because they remind us of the refraction of light. And yet, as we have said, the scientific and the poetical views of Nature ought not, in a well-regulated mind, to war with each other. They are opposite attitudes of the mind, it is true; but they are complementary, and should correct and support each other. Science eradicates superstition. Art teaches us to enjoy Nature without analysis, and Science to investigate her. The artistic interpretation of Nature is one-sided and passive; it is the impression which Nature makes on our sensibility. But the scientific interpretation is active, and engages our reason. Together they employ all our faculties, and we feel not only the sensuous pleasure inspired by the illusions of her beauty, but the rational satisfaction of knowing causes. Nature is no longer to us merely what she seems; we have learned to know, in part at least, what she is. This knowledge must, of course, to a certain extent prune our imagination of some of its false conceptions regarding her; but clearing away what is false cannot be permanently baneful; it ought rather to be, in the end, a benefit. Moreover, for the cherished fancies which she sweeps away, Science often bestows ideas of Nature far more marvellous and grand.

We ought not, however, to be slaves to the scientific view. When we are undergoing a course of purely scientific study it will of course be paramount. But a true education will counteract its influence by the study of art and letters. Scientific knowledge should be worn "lightly like a flower," and in harmony with all other learning. If, owing to our imperfect knowledge and training, Science should overshadow our lives like the baleful Upas tree, let us reflect that it is only because our Science is fragmentary, our training incomplete. For we may rest assured that there is no discord intended between man and Nature. The great and good Michael Faraday, with all his knowledge and scientific habits and thought, could still feel the true poetic ecstasy of the sunset and the lightning flash. Perhaps the profound insight he had into the divine energy at work in both of these spectacles, only heightened the sublime feeling with which he gazed upon the calm beauty of the one and the terrific splendour of the other.

We know that beauty is an illusion of Nature on the senses. We know from Science that sunlight and colour, music and sweetness, have no existence outside of our senses. That which causes the sensation of light is a wave-motion in the luminiferous ether, and sound is due to a wave-motion in the air. But yet colour and sound and sweetness are as real subjectively as matter in motion is objectively. The universe may be silent and dark where there is no mind and sense; but it springs into light and music wherever there is an eye and an ear. The harmonic motions are there, but there needs a new creation to give them meaning, and change them from a dark mechanism into a vision of beauty,—an intelligent being to whom the dismal soulless engine is a minister. The sense of beauty is a divine gift for man to have pleasure in his dwelling-place, and to all but certain exceptional minds it is the most pleasing mode of regarding Nature. It is too precious to lose, and should be carefully cultivated. The old Greek worship of beauty is now impossible, but yet it should receive a due portion of our reverence. Science itself would counsel this, for true beauty means perfect health. The love of literature and art is to be fostered, for these foster the love of beauty and the imaginative and emotional parts of our nature. History and poetry, pictures and the drama, raise us out of the grooves of actual experience and widen the contracted knowledge of life we have gathered from it: they breathe into us broader, loftier, and therefore truer notions of life; for our petty experience would be an inadequate measure of the world. They inspire a reverence for our fellow men and for every living thing. So, too, does Science when we are not immersed in its details, and are free to contemplate its grander revelations. The study of literature and art, communion with Nature, and intercourse with our fellow men, help to raise us to that unbiassed position. Science has no longer a morbid hold on us. We are dragged from the shade of the Upas tree, and can survey it with impunity, finding in it a medicine instead of a poison. Without destroying the reverence, Science, when properly studied, only confirms the truth of the ancient saying, "*We are fearfully and wonderfully made.*" By the comparative study of the lower creatures we may get a higher appreciation of the wonders of our own nature, and still exclaim with Hamlet "What a piece of work is man!"

Not only does beauty link the soul to Nature, but it leads it to something beyond. It induces strange spiritual aspirations. A beautiful sunset evokes ineffable feelings in the soul, infinite longings, and strange dreams of "perilous seas and faery lands forlorn." Can Science chill these feelings by saying that we are tricked by the mere prismatic refraction of solar light in passing through atmospheric vapour—a mechanical illusion of the senses? What then becomes of our mysterious indefinable feeling of the infinite? We may answer that it is as real as the vapour and the solar light, and produced as naturally by the colours of sunset as refraction is by vapour. We may ask if we are not surrounded by that same Infinite which the sunset woos us to reflect upon. But the Infinite, and the why and wherefore we are here, are matters for the soul, and not altogether for chemistry or physics to consider.

A judicious blending of all kinds of culture, then, is what we require, each correcting the extravagances of the other. We should view Nature like an artist, seeing in her the Divine art; we should feel Nature like a poet, seeing in her the Divine spirit; we should know Nature like the man of Science, seeing in her the Divine mode of working; we should seek harmoniously after beauty, goodness, and truth.

What, after all, is the scientific view of Nature? The most we can know is that we can know nothing. Notwithstanding all the advance of positive science, the dictum of Socrates is still profoundly true. We learn a great deal about the actions of certain small bodies believed to exist, called molecules, the stones of the temple of creation. We know many of their groupings and interchanges. We can figure them symbolically as an algebraist writes formulæ. But they themselves are essentially unknown quantities still. We may measure them by the intellect, but we can never see them. They have what we call certain properties, but what they really are is beyond our ken. They must ever remain mere ideas to us. So, after all our Science, we come to mystery in the end. Our reality lands us in ideality. All our Science can only stem back the unknown ocean of truth, mystic and awful, from the organism to the ultimate atom. We can only regard the universe, and man the microcosm, as a whole, whose wondrous construction we may gain some wise insight into, but whose material is an unfathomable mystery.

"We are such stuff as dreams are made of,
And our little life is rounded with a sleep."

IV. ECONOMIC ENTOMOLOGY.*

NO Science is so generally slighted, ignored, and misunderstood as is Entomology. Hysterical humanitarians, novelists, poets, political agitators, classical students, speak in terms of contempt or horror of the "fly-hunter." Pope exclaims sneeringly—

> "O! could the sons of men once think their eyes
> And reason given them but to study flies."

Mr. Ruskin, in his "Fors Clavigera" (Letter 53, pp. 138, 139), writes, certainly not in a lucid moment,—"The instinct for the study of the lower forms of undeveloped creatures is the precise counterpart of the forms of idolatry (expressed in the worship of unclean beasts) which were in great part the cause of final corruption in ancient mythology and morals." Ebenezer Elliott satirises the working-class naturalist who busies himself with examining butterflies and beetles rather than with the speeches and writings of demagogues. At a recent Exhibition a noble lord, pausing before a case of Lepidoptera, expressed a regret that Entomology could not be pursued in a more humane manner.

Such being the state of general ignorance concerning insects and their study, it is time that the eyes of the public should be opened as to the importance of the subject. Strange as it may sound, animals are capable of affecting man's interest and destiny for good or evil, almost inversely as their size. We nowhere find that the presence or absence of any large or individually formidable beast has occasioned famine and pestilence in any region of the globe. But who does not know that both these scourges have been again and again brought on by an inroad of locusts? On the other hand, it is equally clear, though less widely known, that the absence of certain species of insects may render the introduction of valuable crops impossible, or at least unremunerative, in countries where the soil and climate are in every respect suitable. Without humble-bees we cannot have, *e.g.*, clover, or scarlet-runners.

But in cases where insect depredators do not bring on absolute famine, they commonly levy a severe tax upon the produce of the farmer and the gardener, and consequently, *pro tanto*, they impoverish the community at large. The losses occasioned by the *Phylloxera* in France and the adjacent countries, by the Rocky Mountain locust and the potato-beetle in the United States, are matters of general notoriety. So thoroughly have the people of America been impressed with the magnitude of the damage inflicted by these and other vermin, that several of the States have appointed official entomologists whose duty it is to examine into the habits and the life-history of every insect found to be noxious, with a view of devising ways and means for its destruction. In this manner such an amount of benefit has been already effected that our thoroughly practical kinsmen across the Atlantic recognise the outlay thus incurred as a good investment. More than this; they see that a knowledge of Entomology is exceedingly valuable to the farmer and the planter. We in England have not taken any similar steps. If the nation, or any portion thereof, needs chemical, physical, botanical, or zoological advice, we are accustomed to expect that men of Science will not merely give their time and labour gratuitously, but even undertake costly experiments and observations without the prospect of remuneration. We have hitherto not fared badly on this system, unreasonable as it must be pronounced. Nor do we recommend the appointment of, *e.g.*, county-entomologists in England. Were such offices created we fear they would be filled by men who have passed brilliant examinations in all manner of subjects, especially in such as are glaringly irrelevant, but who are utterly useless in research, and whose crammed minds are void of suggestiveness. The writer of the book before us is worth a score of examinees.

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* Manual of Injurious Insects, and Methods of Prevention. By ELEANOR A. ORMEROD. London: W. Swan Sonnenschein and Allen.

It must be at once admitted that insect plagues are less rife here than in America, or, indeed, than in most parts of the great continents. Our chilly summers, our cloudy skies, and the general uncertainty of our climate, are not, upon the whole, favourable to the development of insect-life. We are poorer both in species and individuals than are most countries situate between the same parallels of latitude, or enjoying the same average temperature. Nevertheless the injuries which our crops sustain from "creeping things" are far from trifling, and deserve especial attention now the farming interest has suffered so much from a succession of ungenial seasons.* Perhaps in the long run the extirpation of noxious insects would relieve our agriculturists more than any of the political movements so generally prescribed in modern England as drastic remedies for all the ills a community is heir to.

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* Those who consider that our climate has undergone latterly a change for the worse are reminded that Shakspeare ("Midsummer Night's Dream,"

Let us consider: there are, we may assume, in England and Wales, 24 million acres of land in cultivation or laid out in pasture and woodlands. What is the average loss per acre resulting from the attacks of insects? If we look at the hop-gardens of Kent, Surrey, Worcestershire, &c., we sometimes find the crop reduced by one-half, two-thirds, or even totally destroyed, from the ravages of Aphides, the so-called red-spider (which, though not strictly an insect, may rank as such from an economical point of view), the hop-bug, and the hop-flea. In orchards and market-gardens it is nothing uncommon to find some particular crop,—fruit or vegetable,—otherwise promising, fail from the assaults of caterpillars, the American blight, scale-insects, weevils, &c. Apples, plums, and cherries are often thus swept away. The number of cauliflowers, cabbages, and their congeners riddled by the larvæ of the "cabbage whites" and the cabbage-fly, so as to be utterly unfit for human consumption, is often most alarming. As for the ordinary root and cereal crops of the farmer, they, too, suffer heavily. But let us look rather at pasture-lands, apparently the least liable to damage from insects. We shall often notice the grass and clover turning brownish yellow, and dying off in patches, as if it had been liberally drenched with boiling water or sprinkled with brine. This mischief—which is most common in moist, somewhat marshy districts, on heavy clay soils, and in reclaimed bog-lands—is due to those most un-

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Act II., Scene 2) describes a season identical in its features with "cruel '79":—

> "Therefore the winds piping to us in vain,
> As in revenge, have sucked up from the sea
> Contagious fogs, which, falling in the land,
> Have every pelting river made so proud
> That they have overborne their continents.
> The ox hath therefore stretched his yoke in vain,
> The ploughman lost his sweat, and the green corn
> Hath rotted ere its youth attained a beard.
> The fold stands empty in the drowned field,
> And crows are fatted with the murrain flock.
> And thorough this distemperature we see
> The seasons alter, hoary-headed frosts
> Fall in the fresh lap of the crimson rose."

Let these lines prove that bad seasons were well known in the Elizabethan Age.

comely creatures the crane-flies, or daddy longlegs (*Tipula oleracea*, *T. maculosa*, and *T. paludosa*). When in the larva or grub state these creatures feed in a most destructive manner, cutting off the stems of grass, corn, &c., just beneath the surface of the soil, so that the plant withers. According to Miss Ormerod they destroyed in 1880 hundreds of acres of winter-wheat in the neighbourhood of York. But grass has also other enemies. The wireworms, or larvæ of the various kinds of *Agriotes*, include it among the crops to which they pay special attention. In addition the larvæ of other Elateridæ, similar in their structure and habits, such as *Ctenicera pectinicornis* and *cuprea*, are a great nuisance in the grass-lands of Wales and the North of England. In short, whoever carefully notes the variety and the numbers of plant-destroying insects, and takes account of their ravages from season to season, will not think five shillings per acre an excessive estimate of the loss thus yearly occasioned. Here, therefore, we have a tax of about six millions sterling levied in the first place upon the farmers and gardeners of England and Wales, and of course through them affecting the whole community. It need scarcely be necessary to expound at length that the more cockchafers, daddy longlegs, wireworms, and the like the farmer has to feed, the lower wages he can afford to pay his labourers, the smaller must be his profits and his consumption of manufactured goods. That in many seasons our estimate might be doubled, or even quadrupled, without exceeding the truth is but too probable. Every agriculturist knows well the meaning of finding himself compelled to re-sow a field where the first crop has been eaten up.

Miss Ormerod has made these insects her especial study, and in the work before us she gives a clear, practical description of their appearance, their habits, the circumstances that favour their increase, and the most feasible means for their destruction. In many cases, it must be duly noted, the best remedy consists in restoring the balance of Nature, with which we, like most other nations, have ignorantly tampered. The great patrons and promoters of insect pests are boys who destroy birds'-nests, the bird-catchers who swarm out from our large cities on Sundays and public holidays, gamekeepers, and, perhaps more than all, those crowds of roughs who—without regard to "close times" and to the rights of property—shoot down every winged creature whensoever and wheresoever found. The true sportsman, if he would only instruct his keepers to be less indiscriminate in slaughtering insectivorous birds,—*e.g.*, the so-called goatsucker,—would have by no means an unfavourable influence. We must even declare our opinion that the preservation of winged game, especially partridges and pheasants, is from this point of view a boon to the farmer, and any change in the law which would render such preservation impossible would tend to the increase of noxious insects. The pheasant is a most diligent destroyer of wireworms. The partridge, as well as the rook, feeds eagerly upon the caterpillars of the turnip-moth and other destructive larvæ. Hence the eradication of game might prove a very serious mistake.

The late Edward Newman frequently cautioned the public that if we increase the quantity of any special crop so as to attract some special insect, and at the same time destroy the birds which feed on such insect, we must expect to suffer. Miss Ormerod repeatedly calls attention to the services of the ladybirds (Coccinellidæ) in freeing the hop and other plants from Aphides. It is unfortunate that many people are ignorant enough to confound the ladybird with the bedbug, and destroy it accordingly, We do not see mention made in this connection of the *Telephori* (soldier- and sailor-beetles). These creatures are more active and voracious than the ladybirds, and generally more numerous, so that their utility as destroyers of plant-lice is proportionally greater.

From the study of this book, and indeed from that of Economic Entomology in general, certain very important biological lessons may be learnt. Among the prominent tenets of the Old Natural History it was formally laid down that the diet of every animal species was constant, the structure of the stomach and intestines, and even the chemical character of the gastric juice and the bile, &c., being specially arranged accordingly. This was theory, or rather assumption. Careful observation teaches us something very different. We find that a species, as it spreads into new habitations, sometimes alters its diet, and thus suddenly becomes a scourge to the farmer. We see, also, that animals even when not pressed by hunger—and much more when this is the case—will consume nourishment quite at variance with our traditional opinions. The catalogue of living beings which are either purely carnivorous or purely herbivorous is not nearly so extensive as it was formerly supposed.

Another point which has come of late into very distinct prominence is that the organisation of an animal, and the general character of the group to which it belongs, are no sure clues to its habits. Of this we have an excellent illustration in Miss Ormerod's work. We find here the figures and description of *Silpha opaca,* a beetle which in France, Ireland, and elsewhere has been observed to occasion much damage to mangolds, beets, &c., sometimes ruining entire crops by devouring the leaves as they appear above the ground. Yet this creature, which thus proves itself abundantly herbivorous, if not an absolute vegetarian, belongs to a group of carrion-feeders which may be called insect representatives of the vulture or the hyæna. One of its near kindred, further, *Silpha quadripunctata,* feeds almost exclusively upon living prey in the shape of caterpillars, &c. It is therefore instructive to find, in such a family, one member at least which is able to subsist upon the leaves of plants.

Again, the Geodephaga are well known to be a distinctly carnivorous group of beetles, specially organised for capturing and devouring other insects. Yet, in the course of their researches, American entomologists have distinctly proved that several members of this group are clearly, if not exclusively, plant-eaters. *Zabrus gibbus,* a British insect belonging to the same tribe, appears to devour the ears of corn. We have observed more than one species of *Carabus* proper feeding upon fruit, and even coming to the patches of sugar smeared upon tree-trunks to attract moths—a repast of which even spiders will partake.

Another consideration suggested by this work is that few insects—indeed few animal species of any rank—are unmixed benefactors to man. An insect may serve us by aiding in the fertilisation of the blossoms of our food-plants, or by making war upon noxious species, but may yet, at the same time, be itself guilty of more or less mischief. Thus we find here reference to the fact that the humble bees—without which some most important crops would be doomed to sterility—occasionally render the blossoms of the bean abortive by perforating the calyx so as to get at the honey within. The authoress, however, very justifiably doubts whether the damage occasioned is ever serious.

Another case of the kind is that of the common wasp. Its depredations on the choicer kinds of fruits bring down upon it the hostility of the gardener; and in many parts of the kingdom its numbers have been much thinned by the destruction of the queens in spring, when they are seeking a site for their future nests. But, on the other hand, the wasp serves mankind by capturing and devouring many blow-flies, and other Diptera, which one moment may settle upon carrion and the next upon our food or our persons, and may thus convey to us some deadly virus. In all such cases the good and the evil should be carefully weighed, and no attempts at general and systematic destruction should be made till the evil has been found to preponderate.

There is another lesson to be learnt from this book, of especial moment in these hysterical times, though not needed in former days. Nature gives us merely the option of destroying or being destroyed. A general renunciation of animal food, as recommended by the Vegetarians, and it seems by the "Occultists," would not exempt us from the necessity of constantly taking animal life. The farmer and the gardener kill, and must kill, a far greater number of creatures than does the butcher, the sportsman, or the fisherman. It is true that when insects, snails, and others of the lower animals are crushed, we do not see a red liquor emitted, and we may therefore flatter ourselves with the notion that we are not shedding blood,—a plea that reminds us of the Holy Inquisition, who, when sentencing a man to the stake, declared—"*Ut quam clementissime et citra sanguinis effusionem puniretur.*" But if man is not justified in putting to death sheep and oxen for food, neither is he at liberty to kill wireworms, cockchaffers, and the like, for the same ultimate end.

Miss Ormerod's work must be pronounced a most valuable contribution to the literature of scientific husbandry, and will, we hope, convince men of the world of the practical importance of entomological science.

V. ON THE POISON OF SERPENTS.

A FEW months ago ("Journal of Science," 1881, p. 734) we gave a summary of the researches of Prof. Selmi and Dr. Gautier on a newly-discovered class of animal poisons. These compounds, the so-called ptomaines, were found to agree in all their essential properties with the venom of serpents. Both appeared to be definite chemical "individuals," capable of crystallisation, retaining their fatal properties after boiling, acidulation, repeated filtrations, desiccation, and even heating up to 257° F. for several hours. On the other hand, by a sufficient degree of dilution or by a reduction of the dose, they might be rendered harmless. On the faith of these observations Dr. Gautier argued—and as it seems to us quite legitimately—that snake-poison could not be a virus or figured ferment, owing its deadly efficacy to the presence of microbia, or organic germs, as is the case with the *materies morbi* of splenic fever, &c. We pointed out then that the eminent Brazilian physician Dr. de Lacerda had come to very different conclusions. The views of the latter *savant* appear to have been endorsed by one of the chief representatives of French official Science—M. de Quatrefages—in a memoir presented to the Academy of Sciences. This paper we shall beg to lay before our readers, premising that, whilst Dr. de Lacerda has experimented chiefly with the venom of *Bothrops jacaranda*, Dr. Gautier has examined that of a closely-allied species, the redoubtable lance-headed serpent of Martinique, which some zoologists place in the genus *Bothrops*.

M. de Quatrefages commences by referring to some of the cures effected by Dr. de Lacerda by the subcutaneous injection of a dilute solution of potassium permanganate. He says—"Among the cases recorded there are some exceedingly remarkable, where the injections have not taken place until eleven and twelve hours after the bite. Extreme swelling of the limbs, profound anxiety, and hæmorrhage, inward or outward, all announced the approach of death. Yet after some injections all these symptoms have disappeared, and the wounded persons have been completely restored in a few days. These facts, collected in different parts of the Brazilian territory, and accompanied with minute details, seem to be beyond all doubt. They confirm the experiments made by Dr. de Lacerda in presence of the most competent judges, and with the assistance of one of our countrymen, Dr. Couty, a pupil of Claude Bernard.

"To comprehend all the importance of the discovery due to Dr. de Lacerda, we must remember that in those countries a certain number of persons succumb every year to the bites of various species of serpents. In Martinique alone, with a population of 125,000, the annual mortality from the bite of the lance-headed snake is fifty, not counting those who remain lame or infirm for the rest of their days. We see, therefore, what a service the eminent sub-director of the Physiological Laboratory of Rio Janeiro has rendered. France itself may profit by this beautiful discovery. Without doubt, of all our serpents, the viper alone is venomous, and its bite is far from being as formidable as that of its tropical congeners. Yet the viper does more damage than is commonly supposed. The question has been repeatedly laid before the Society of Acclimatisation. In 1859 a commission was nominated to examine into the matter; an inquiry was instituted, and in 1863 a report was drawn up by M. Soubeiran. From the evidence collected during these four years it results that if some departments do not seem to produce vipers (Nord, Haute-Saône, &c.), and if in others they are rare (Meuse, Vosges, Bouches de Rhône, Oise, Corrèze), there are others where these reptiles swarm to such an extent as to constitute a real danger for the inhabitants of the country (Vendée, Loire-Inférieure, Haute Marne, Lot, Côte d'Or). Here rewards have at intervals been offered for the destruction of vipers. These measures have generally produced good results. In Haute Marne, in the year 1856, the number of these reptiles brought in to the local authorities was 17,415. In six years the destruction of 57,045 venomous serpents was officially certified.

"Unfortunately the enquiry led to no precise information as to the number and the nature of the accidents caused by the bite of vipers. It appears merely that our large domestic animals recover very rapidly, and without requiring any treatment, whilst sheep and goats frequently perish if they do not receive prompt assistance. It is often the same with dogs, especially if bitten in the nose. But even after a cure they often remain all their life long extremely weak, and suffer from defects of sight and hearing, which render them unfit for hunting.

"It has long been known that an adult man, if bitten by a viper, may recover spontaneously. But we know also that in this case the phenomena, both local and general, are more pronounced, and very often lead to a fatal termination. In any case they are ordinarily grave and painful. There is room to hope that the means of cure discovered by Dr. de Lacerda will enable the symptoms to be arrested promptly and with certainty. The process succeeds as well with animals as with men.

"In describing his process Dr. de Lacerda insists on the necessity of preparing the solution of permanganate at the moment when it is to be used. He makes up beforehand small packets of the salt, each containing 0·1 grm. (about 1½ grains), and a flask containing 10 grms. of water. He obtains thus, at the required moment, a solution of the exact strength needful. The injection is made by means of a Pravaz syringe. A ligature should be placed above the bite, and half a syringeful of the liquid should be injected into each wound made by the teeth of the reptile, and the tissues are then compressed to favour the diffusion of the liquid. If the limb is already swollen several injections should be made about the boundaries of the swelling. If the rapidity of the symptoms seems to indicate that the venom has been introduced directly into a vein, an injection should be made into a superficial vein.

"I may be permitted here to add a brief reflection: from researches anterior to those of Dr. de Lacerda it results that the venom of serpents owes its toxic properties not to the liquid itself which is secreted in the glands, but to corpuscules more or less analogous to those discovered daily in virus. Is there here a hint to be taken? Would potassium permanganate, so powerful against the venom of the *Bothrops*, do similar service if employed against some of the diseases the cause of which has been discovered by M. Pasteur?"

This memoir suggests a few remarks. We note, in the first place, that the learned Academician accepts already as a demonstrated fact the efficacy of potassium permanganate for the bites of serpents. Now, unless our memory greatly deceives us, it has been tried repeatedly, and in vain, for the bite of the cobra in India. We are, however, quite willing to admit that the poison of the cobra and that of the *Bothrops* may differ quantitatively, and even qualitatively, that of the former being beyond doubt the more malignant.

Still it appears somewhat rash to pronounce Dr. de Lacerda's method of cure successful just when its value has been referred to a Select Committee of the Academy for close examination. Pending the conclusion of such inquiry suspension of judgment would, we submit, be the proper course.

As regards the number of vipers in France, we fear that there has been an increase during the last twenty years. This has been especially the case in the Gironde, where their only efficient enemy, the hedgehog, has been much persecuted by gamekeepers. As regards the danger of the bite to man, we believe that it is much under-rated in zoological text-books. From evidence which has reached us, and from our own observations, we should think that about one case in five proves fatal, the danger increasing with the heat of the climate and of the season, and with the fatigue or the constitutional weakness of the subject. Many of our readers will recollect that a few years ago a young man died from the bite of a viper received on Leith Hill, It must be remembered that these reptiles are increasing in England as well as in France, and from the same cause—the extirpation of the hedgehog. We have repeatedly seen them in Epping Forest, and in some of the Hertfordshire woods they are numerous. No one seems to have observed whether in England and France they show a marked preference for any particular kind of vegetation, as in Eastern Europe they do for the marsh-rosemary (*Ledum palustre*).

At the close of his memoir M. de Quatrefages formally accepts the ferment-theory of serpent-poisons as if already established by "anterior researches." In so doing he completely ignores the investigations of his own eminent countryman Dr. Gautier, as well as those of Dr. Winter Blyth.

There is another point which we cannot overlook; the remedy for snake-bites, if such a one exists, can only be found out by experiments upon animals, which in the hysterical cant of the day are denounced as "violationism," "diabolism," &c. We would therefore ask whether, seeing that in India alone some 50,000 persons perish yearly from snake-bite, such experiments are not the imperative duty of those who have the opportunity and the skill to perform them? If any person, whether prelate or homœopathist, whether judge or doctress, can suggest another method, the scientific and medical public are prepared to hear. Dr. de Lacerda has reached his conclusions solely by means of experiments performed upon animals!

VI. ON TECHNICAL EDUCATION.

By Robert Galloway, M.R.I.A.

(Continued from page 156.)

THE workshop in the school, the school in the workshop, and other forms of what are termed Apprenticeship Schools, have all been tried, and exist at the present time in France; and in some form or another they have been established in most Continental countries; but France is the country in which they have been most developed.

It has been proposed that schools of a similar kind should be established in the United Kingdom; and it is chiefly with the object of enquiring into, and reporting on, the success of this class of Technical Institutions on the Continent that the Royal Commission on Technical Education has been appointed.

The aim and object of these Continental schools is to train those intended to be artizans, not only in ordinary hand work, but in handicrafts that are more or less undeveloped in the respective countries; and especially to train them to equal our own craftsmen in those industries in which we have hitherto had the supremacy. The reason adduced for the necessity of establishing such schools in this country is owing to the change that has taken place in recent times in the apprenticeship system. The master of the present day, it is urged, unlike the master in olden times, is not acquainted with his craft; he, as a rule, is simply an employer of labour, a capitalist, and not a craftsman; hence he is incompetent to teach—as was formerly done by the masters—the apprentice his trade. The apprentice of even average intellect now acquires in consequence a very imperfect knowledge and skill, it is stated, of his trade, as he is left to learn it from those—the foremen and the other workmen—who have no interest, pecuniary or otherwise, in teaching him.

The Commissioners will, it is to be hoped, not only give the nation the benefit of their opinion as to how far these Apprenticeship Schools have fulfilled the purpose for which they were established in foreign countries, but what is much more important for the nation to know, how far, and in what way, they think they would be likely to benefit, not any particular craft, but all our various manufacturing industries, by giving those intended to be artizans a suitable education previous to their being apprenticed to any trade, and what kind of administrative and other machinery ought to be employed for properly carrying out such a system of technical education.

It may not be inappropriate or undesirable to consider, even before the Commissioners make their report, whether such a system of technical education is the one best fitted to render our artizan classes more efficient craftsmen. And in considering the subject, the education America is providing for its artizan class ought not to be overlooked; for we have more to fear, I believe, in the future from the industrial productions of that country in our own and other markets than from the productions of Continental nations. The raw materials we have, which have very greatly assisted in making us the leading manufacturing country in the world, exist in greater abundance in that country than in our own; and America possesses in addition at least one raw material, cotton, which we do not possess, and on which one of our great staple industries is based, and they are beginning to try and supersede us in cotton goods on the continent of Asia, which at the present time is our best neutral market for that class of manufactures. The singular talent their mechanists have displayed in the invention of labour-saving machines and other mechanical inventions is well-known: the cheap labour of Switzerland is no longer able to compete with their automatic machinery in the manufacture of cheap watches and clocks, and horological apprenticeship schools will never be able to train workmen to compete with their machinery in this branch of manufactures. And yet they have, I believe, no apprenticeship schools, but rely on the good public education they afford every class of their citizens, to fit each class for their future pursuit in life. And their brain-workers and hand-workers certainly appear much more capable than those classes do in the older civilised countries of engaging in a greater variety of employments, from the greater flexibility, if I may so term it, they display of mind and hand. This greater universality was well illustrated at the close of their war, each officer and soldier when disbanded entering upon some civil employment. This greater adaptability may be due in a measure to the fact that America is as yet a comparatively new country, and therefore the avenues to employment are not so over-crowded as in older countries.

In all schools where the training of the hand as well as the mind is undertaken, the exercises employed for hand training should be of such a nature that the manipulator would acquire the greatest dexterity of hand in performing them. But not only should these *manual exercises* impart manual dexterity, but they should likewise be of such a character that the eye would be systematically and artistically educated. The Apprenticeship Schools, on account of the nature of the manual exercises given to the students, do not evoke this scientific manual skill, and the French, who have tried these schools to the fullest extent, are beginning to perceive it. They say "that the art industry of France is being lowered, and that the young idea must be more ably taught and tutored in the way it should go. At recent exhibitions it was shown," they state, "that England was on a level with France in the furniture and china departments; that Austria was on a level with France by reason of her bronzes; that Italy was on a level with France by reason of her glass ware; that Japan is becoming a dangerous competitor; and that Belgium and America are making giant strides; and therefore France must make up her mind to give her workmen *a complete artistic education, and better opportunities of widening their intelligence and increasing their knowledge*." And when M. Ferry was recently presiding over the French Commission on Art Industries he dwelt on the necessity of "Awaking in the artizan the slumbering artist, not to disgust him with his calling, but to elevate it, and make it both more profitable and more attractive. Drawing must be obligatory," he said, "in every stage of education, and the effects of machinery and the excessive sub-division of labour must be counteracted. Individual initiative must be encouraged, *and anything like official teaching in cabinet-making, pottery, &c., must be avoided*."

The experience the French have gained with regard to the defects of these Apprenticeship Schools should not be neglected by those who have the direction and management of our educational departments. Let us cease piling one educational institution upon another, but let us simplify and render more efficient our educational machinery, and reform and reconstruct, if necessary, our existing institutions.

Our workshops and manufactories are, I believe, the best technical school our artizans could have for learning and acquiring skill in their trade; but they, like those who are intended for directors of industries, require a school education that will best prepare them, both mentally and manually, for their future avocations. It should embrace, in addition to the three R's, the elements of mathematics and the principles of mechanics; drawing should be carefully and systematically taught in its various branches, not by means of copy, but from objects; and something likewise of the sculptor's art ought to be taught. Hand and eye would thus be efficiently trained as well as the mind. Such an education would greatly excel the teaching of cabinet-making, pottery, &c., in training the future artizan to be an intelligent and efficient workman. But then the teaching of these subjects *must be real and highly efficient*, so that a sound foundation is laid on which the taught can afterwards raise a suitable superstructure. Thorough instruction at school is even more necessary for the artizan than for any other class; for if he has been imperfectly taught it is too much to expect that he will devote a portion of his few leisure hours in re-learning and continuing his studies. For the difficulties that beset the artizan in pursuing serious studies during his leisure hours are very formidable even under the most favourable circumstances, for the *energy* each person possesses is limited, and much of the artizan's energy has to be expended on his daily manual labour; consequently, if he has to contend, along with exhausted energy, with imperfect training at school, it becomes well-nigh hopeless. I have directed attention to this subject in my work on Scientific and Technical Education, as it is not only important, but one so frequently unthought of, or overlooked, by those who have the framing of educational schemes for instructing the industrial classes in their leisure time.

Professor Goldwin Smith, in his address to the Social Science Association last year, alluded to this subject in connection with the Cornell University, of which he is one of the Professors. In this University manual and mental labour are combined:—"The University," he stated, "had succeeded in a general way. *But the special plan suggested to the mind of its benevolent founder by his own history, of enabling poor students to maintain themselves by manual labour while they received a University education, must be said to have failed.* Mental and manual labour draw on the same fund of nervous energy, which will rarely suffice for both, and in ordinary cases excellence can only be attained by undivided attention to study."

Although to many workmen the further progress in mental studies which require much concentration of thought will, after they leave school, be impossible on account of the great exhaustion of their energies on their daily labour, yet there ought to be evening schools or colleges accessible to workmen, so that those of them who are more fortunately situated as regards the nature of their employments, might thus have opportunities afforded them of pursuing their studies. The character of these colleges or schools as regards the subjects to be taught, the management of them, &c., will be considered further on. Along with the school or college there ought to be accessible to the artizan Libraries, Art and Technical Museums, and the means of securing Patents for inventions ought, by a reform of our Patent Laws, to be within the reach of inventors in humble circumstances.

Good public libraries now exist in almost every English town of any importance, but Art and Technical Museums have not been supplied or aided by the State in the way they ought to have been in the Provincial towns, and if these accessories to technical and artistic teaching are wanting, much cannot be expected to accrue from merely a good preliminary education. Much valuable evidence on this and kindred subjects was given before a Select Committee of the House of Commons on Schools of Art, in 1864, by the then largest calico printer in the world, Mr. Edmund Potter. "I attribute," he stated, "the original superiority of French designs for calico-prints, altogether to the atmosphere of taste which an artist lives in in France. I remember sending over two young men to Paris to design for my own house; we had them there for some time, and while they were there their designs were equal to the French, *but when they came back to us there was not the same artistic atmosphere surrounding them, and their designs went back again.* It is not likely, as was suggested just now, that a man would have the same taste in the back streets of Manchester that he would have in Paris, *with the chances of refreshing his sight with everything fresh and beautiful.* I take it that Paris is the best market in the world for the designs of our class, at least it has so proved."

Mr. Potter stated that he believed the entire payment at that time by the English calico-printers for French designs alone was upwards of £50,000 a year. Notwithstanding the murky atmosphere of our manufacturing towns, if an atmosphere of art were created by the establishment of Art Museums, we might expect to return to the more fortunate position we were in previous to 1840. At that period there was considerable employment for English designers. Most of the calico-printers kept up large establishments, and there were many men receiving from £100 to £500 a year as designers for the trade; and in a large school in London that existed at that time, there were individuals connected with the school who realised as much as £1000 a year by designing patterns. But when the Manchester people asked for a small portion of the grant voted yearly by the State for art education, they were informed their lordships could not grant it, as State aid would sap the self-reliance of the provinces; they must therefore depend upon themselves; and this opinion has been practically adhered to up to the present time. The Commissioners for the Exhibition of 1851, answered the deputation of provincial municipal representatives who waited upon them at Marlborough House in July, 1877, in pretty much the same terms, when the deputation asked them to give the provinces a part of the money they still had at their command for the purpose of fostering art and its applications. But self-reliance, self-dependence are never raised up as obstacles to the granting of State money for Art Museums, Art Collections, &c., in the wealthiest City in the world; and these grants go on increasing year by year, and the wealthiest part of the Capital of England receives the lion's share of them.

The establishment of Art Museums in London cannot create an art atmosphere in the provinces; just as a school established in London could not teach those who live in the country; and it is in Art Museums that the artistic artizan, as well as the technical artist, must perfect his taste and seek for inspiration, as the landscape painter seeks for inspiration by living a portion of his life amid the most beautiful scenery. Mr. Potter's answer to a question on the expenditure at South Kensington is as true to-day as it was when spoken in 1864—"I think there is too large an expenditure there, and too little in the country, and that it ought to be shared *if it is desirable to promote technical art teaching at all.*"

It is to be hoped that some practical plan, which will prove beneficial to the nation at large, will result from the interview which took place, on the 8th of March, between the Lords of the Committee of Council on Education and a highly influential deputation, introduced by Mr. Jesse Collings, M.P., with respect to the establishment of local museums. The deputation was not on this occasion put off with the stereotyped official answer that the provinces must rely upon themselves, and therefore it is evident that the Government feel that, even in the interests of trade and commerce, they can no longer oppose the granting of aid towards the establishment of Museums in the provincial towns. Mere loans of art objects from the South Kensington Museum will not accomplish the object sought. There must be ever present an art atmosphere, and this can only be attained by having, as in London, permanent museums. And if the collections in these provincial museums were varied for each museum, and made interchangeable at stated periods, there would thus be provided for each locality a large art collection at a comparatively small cost; and by the exchange freshness and novelty would be imparted to each collection, and the freshness and novelty would be most fully sustained, and the practical difficulties connected with the exchange overcome, if only a portion of the collection of each museum were interchanged on each occasion.

VII. THE LESSONS OF THE LAMSON CASE.

IN referring to this celebrated trial we shall take an entirely different point of view from that of our contemporaries. The questions of the guilt of the prisoner, the degree of his demerits, and the effects which his condemnation may have upon his relatives, we must put aside as completely as our modern humanitarians in such cases do the sufferings of the victim, the distress of his friends, and the feeling of insecurity occasioned to society at large. We have merely to ask how are the interests and the duties of Science affected by this murder and the subsequent trial.

We must in the first place notice the plea raised that the alkaloid discovered in the corpse of the youth John, and which when administered to mice produced the well-known symptoms of poisoning by aconitine, *may* have been one of those newly-discovered bodies, the ptomaines. It is perfectly true that our knowledge of these bodies is still very rudimentary: we neither know the exact circumstances under which they are produced, nor the exact nature of their action when administered to warm-blooded animals. But our knowledge, as far as it goes, is decidedly against the theory that the substance isolated by the chemical experts from the body could be a ptomaine. The symptoms observed in experiments with these compounds have more closely approached those of poisoning by strychnine than by aconitine.

We must also remember that this theory does not account for the death of the youth under circumstances which strongly indicated the action of a poisonous alkaloid. But a practical lesson to be drawn here is the danger of incomplete researches, especially on such subjects. Half-knowledge may readily serve the purposes of an advocate, and enable him at least to bewilder the not too clear mind of the British juryman. But how is a more complete knowledge to be obtained? We do not see any possible way save by experiments upon animals—in other words, by what is now shrieked at as vivisection. We ought to know not merely the chemical characteristics, but the physiological action of every "ptomaine," if these bodies, like legion, are many. To this point we shall have to return below.

Another very important consideration is forced upon us by the presentment of the jury in the Lamson case, and by the outcry in the political and literary papers anent the sale of poisons. There is reason to believe that any additional restriction imposed on such sale will be felt as a serious hindrance to chemical research, and will become an annoyance in a number of arts and manufactures. The public does not know that hundreds of substances absolutely indispensable for many legitimate purposes will prove poisonous if anyone is foolish enough to swallow them. But are we on this account practically to prohibit their sale? Are the important uses of "poisons" to be checked because in some infinitesimal number of cases they may be applied to criminal purposes? Let us in the first place remember that by all our grandmotherly legislation we cannot prevent a determined criminal from getting possession of such bodies. The utmost we can effect is to make it hard or impossible to prove such possession. In this case Lamson obtained the deadly drug at a chemist's shop, and this fact, brought out in evidence, was a link in the chain of proof against him. Suppose that he had not been able to purchase it—at least without formalities which might not suit his purpose—what is he to do? Monkshood, the source of aconitine, is a common garden flower. What could hinder him from obtaining a root? The extraction of the poisonous principle in a pure form would not be beyond the skill of a man who has received a medical education. If he had been seen experimenting with herbs the circumstance would have excited no suspicion, and it might have been very hard to prove that he had had any aconitine in his possession. Quite the same with other poisons of the same group: nux vomica, deadly nightshade, the young shoots or eyes of the potato, tobacco, certain fungi, which for the present it might be indiscreet to name, the seeds of the laburnum, and many other vegetable products which may be acquired without suspicion and without anyone recording the fact, are the raw materials for these agents. The preparation is far from difficult. If, then, we really wish to render poisons inaccessible we must send out a Royal Commission to go through the realm digging up and destroying every plant, wild or cultivated, which may possibly contain poison. Our imports must be put under severe restrictions. Every bag of myrobalans—a nut used in tons by the dyers and tanners—must be carefully searched through lest, as is sometimes the case, the nuts of the strychnine plant (*Nux vomica*) may have got mixed among them.

We must also ask why should poisons be watched over and restricted more than other deadly agencies? Their possession constitutes a far smaller public danger than, *e.g.*, explosives. The number of people who have fallen victims to poisons is an unconsidered trifle in comparison with those who perish by pistol shots, or by dynamite and the like. However criminally disposed a man may be, he can exhibit poison to those only who live with him, or with whom at least he comes in very close contact. The burglar or the garotter cannot administer a dose of aconitine or strychnine to a substantial citizen on his way home from business. Potassium cyanide will not enable demagogues to blow up ships or prisons. Further, the legitimate uses of firearms and explosives are much fewer than those of the numerous and heterogeneous bodies which are included under the name "poisons." It must also be remembered that many bodies, though deadly if introduced into the stomach, are so peculiar in their taste and smell, or in the effects they produce upon any article of food or drink with which they may be mixed, that no person is likely to swallow them. We would therefore say if the common sale of sulphuric and hydrochloric acids is to be prohibited, a thousand times more should restrictions be placed upon the traffic in revolvers, cartridges, and dynamite. Such articles should be made inaccessible to all whose purposes and past career are not absolutely free from suspicion. Next to explosives the sale of anæsthetics should be most carefully watched.

The third point we have to consider in connection with the Lamson case is of a very different kind. We were astonished to find Lord Chief Justice Coleridge quoted to show the untrustworthiness of experiments upon animals as regards the action of poisons. We must utterly refuse to acknowledge him as an authority on such a question, believing as we do that he has no personal experience in this matter, and knowing his strong anti-vivisectionist bias. It was, we believe, Lord Coleridge who sought to defend anti-vivisectionists from the charge of inconsistency by the threadbare plea that "one wrong does not justify another." Now, even admitting, which we cannot, that experiments upon animals are a "wrong," they are so rare in occurrence, and in most cases they inflict so little pain, that they sink into insignificance. We would therefore remind the Lord Chief Justice that an Authority, generally considered higher than that of the judicial bench, exhorted the fanatics of old to get rid of the beam in their own eye before dealing with the mote in that of their neighbour.

But why or when should experiments with poisons upon animals be untrustworthy? Only if such poisons affect different animals differently, and if we do not know their exact action upon the species we select for the experiment.

Now, differences in the action of poisons upon different species do occur, but they are most decidedly the exception, especially if we confine ourselves to vertebrates, to warm-blooded creatures, and still more to mammals. Many of the supposed anomalies and exceptions disappear on close examination. The poison of the cobra has proved fatal to every animal upon which it has been fairly tried. The mungus and the secretary hawk owe their success in giving battle to the death-snakes, not to any immunity from serpent poison, but to their adroitness in evading the bite. Swine are said to suffer little from the bite of the rattlesnake. But in fact the venom loses itself in the dense layer of cellular tissue loaded with fat, which underlies the skin, and rarely penetrates into a vein. We have often seen the hedgehog kill a viper, regardless of its bites. But these bites struck merely the cartilaginous mass of Hoggie's snout, and the poison doubtless failed to enter the circulation.

Dr. James Blake,* as the result of a course of experimentation extending over forty years, records the fact that the action of forty-one mineral poisons introduced into the blood was the same in all the species operated upon. Let us, however, suppose that certain poisons may, whilst others may not, produce the same symptoms in man and in some of the lower animals. We have then the two cases:—(*a.*) The symptoms in man and in, say, a rabbit or a mouse are identical. In this case there is no difficulty; the experiments will be perfectly trustworthy. (*b.*) The symptoms in man and in the rabbit are different. Here, also, there is no difficulty provided the symptoms in each case are perfectly known. Let us suppose that a man has died, apparently from a dose of aconitine, that is to say, the symptoms produced are those which aconitine is known to excite in human subjects. We extract from the contents of the stomach an alkaloid. We administer this alkaloid to a rabbit, and we find it dies with the symptoms which aconitine produces in rabbits. The results are therefore in either case trustworthy provided that the physiological effects of the poison in question are duly known. Hence the argument which the Lord Chief Justice is said to have used, instead of showing the uselessness of experimentation upon animals, proves its necessity.

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* Journal of Science, vol. iii. (3rd series), p. 319.

ANALYSES OF BOOKS.

Force and Matter. Empirico-Philosophic Studies, Intelligibly Rendered. With Introduction, written for the English Edition, by Dr. Louis Büchner, President of the Medical Association of Hessen-Darmstadt. Edited by J. F. Collingwood, F.R.S.L., F.G.S. Third English Edition. London: Trübner and Co.

The present edition, in which the author has not found it needful to introduce any additions or emendations, may fitly serve as an opportunity for attempting an estimate of a celebrated work. Concerning Dr. Büchner's introductory letter to the Editor and the five additional prefaces, we need say the less as they are in great part replies to criticisms with which the English public is not familiar. We note that Mr. Collingwood does not "bring out this volume as one entirely in accordance with his opinions, for he cannot always subscribe to the alleged facts contained therein, nor does he agree in all the inferences drawn from these facts." We find further, at the outset, a very remarkable statement made by the author. He considers that among his own countrymen "the belief in the wonders of a supersensual speculation still appears to be stronger than the faith in reality," and hence he anticipates that his "work may not, in England, have to struggle against such gross misinterpretations as was the case in Germany." Now we generally understand that in Germany speculation in science and philosophy is freer, bolder, less fettered by conventionalism and prejudice than in our own country. Dr. Büchner, it seems, is of a different opinion.

The work before us does not bring forward either novel facts or new generalisations. Nor was such the author's intention. He seeks to deduce from the conclusions of modern Science—or from what he accepts as such—a philosophy of life for the use of the general public. As materials for his task he admits the generally received doctrines of the indestructibility of matter, the conservation of energy, and the immutability and universality of the "laws of Nature"—a term we do not like. He recognises uniformity in geology and evolution in the organic world. In common with most conscientious observers of animated nature, he holds that the distinction between the souls of mankind and of brutes is not qualitative, but quantitative. But he dissents from orthodox science, if we may be allowed the expression, in accepting so-called spontaneous generation. The teleological interpretation of natural phenomena he rejects. A distinct vital force he is not able to admit. Innate ideas, personal continuance after death, the freedom of the will, and the idea of a personal God are also set aside. Hence it appears that the author is sufficiently "advanced" in his views, and that his work is in its character extra-scientific, if not in some of its fundamentals, yet in its results. Hence he appeals not so much to the men of research, of experiment, and observation as to those minds who crave for general conclusions, even if resting upon an insecure basis. That the author's learning is wide, and that he tells us many interesting and little-known things, must be admitted. We read—"Schubert speaks of a spontaneous origin of water in sudden accumulations of clouds; Röbbelen thinks that the animal organism produces nitrogen, and even the celebrated Ehrenberg appears yet doubtful whether the organisms create or merely transform the materials they contain"! Miracles he declares impossible, on the questionable ground that they involve a departure from or a violation of the laws of Nature. In a passage questioning the order and symmetry of the Solar System, the author, quoting Hudson Tuttle, asks—"Why did the Creator give rings to Saturn, which, surrounded by its eight moons, can have little need of them, whilst Mars is left in total darkness?" As Mars has been found to have two moons, this passage, we submit, might have been fairly modified.

The evidence which Dr. Büchner gives in support of abiogenesis seems to us singularly weak, and little in harmony with the results of recent investigations. If we do not misunderstand him, he adduces on behalf of this view the appearance of intestinal worms in special parts of animals; the origin of Infusoria, "where air, heat, and moisture combine;" the upspringing of vegetable species not previously known in the district, where a forest has been burnt down or a lake drained. "Where a saline spring gushes forth there soon appear well-marked *Calophites* and salt-water creatures, no trace of which is to be found for many miles around. Since the increase of pine-plantations in the environs of Paris there is met with the lamia (*Lamia*, or rather *Astyonomus, edilis*), an insect belonging to Northern Europe, which had never been seen in the above region." We have taken the insect in question in regions situate farther south than Paris, and, as it is swift and powerful on the wing, we need not feel surprised that it has taken up its abode in the pine-woods above mentioned.

The author's assumption that the entombed elephants in Siberia are proofs of a "much higher" temperature than now prevails may reasonably be challenged. Those elephants were coated with long woolly hair, and within the frozen bodies have been found portions of plants which had evidently been swallowed as food, and which are identifiable as similar to the modern vegetation of Northern Asia. That at certain epochs the temperature of the earth must have been higher than it is at present is, however, indubitable.

The author asks, with reference to the idea of design in Nature,—"Could a being, acting from goodness and benevolence, endow the cat, the spider, and man with a nature capable of all these horrors and cruelties?" Dr. Büchner seems here to fall into the error of judging natural phenomena from a narrow and exclusively human point of view. Why should we pity the animal that is eaten more than the plant which is devoured and trodden down? That the one is conscious of feeling and the other not are assumptions far from demonstrated. To us personally it is far more revolting to see a carnation destroyed by earwigs, or a rose spoiled by Aphides, than to behold the earwig seized by a *Goerius olens* or the Aphides massacred by a ladybird.

In a passage quoted from Count Goertz the negro is pronounced "devoid of any religious feeling." This is scarcely correct.

In the chapter on the "Brain and the Soul" we find the interesting and very just remark that "short-necked persons are lively and passionate; long-necked persons are calm and sedate."

Spiritualism meets in this work with scant courtesy. Says the author, "What the belief in sorcery, witchcraft, demoniac possession, vampirism, &c., was in former centuries, reappears now under the agreeable forms of table-moving, spirit-rapping, psychography, somnambulism, &c." Anyone reading this book, or "*Aus der neuen Hexenküche*," will see that Mrs. Kingsford's word of abuse is nothing novel, and that in hurling it at Modern Science she is merely using that vulgar flower of rhetoric "Y' are another."

The author's assertion that the common house-fly is deaf may be doubted. It has been observed that these unpleasant insects seem to recognise the peculiar buzz made by one of their number which has got ensnared in a cobweb, and at once take their departure. With Dr. Büchner's remarks on "Instinct" we heartily concur.

The question of free will is not one which can be discussed in the "Journal of Science."

"Force and Matter" possesses no small interest as characteristic of a certain school of modern thought, but in our opinion it requires very considerable revision. Certain of the conclusions reached are put forward with a confidence scarcely befitting the not unimpeachable evidence upon which they rest.

The Perfect Way, or the Finding of Christ. London: Field and Tuer, and Hamilton and Adams.

On opening the anonymous book bearing this not unassuming title we expected to find a religious treatise the examination of which we must decline as outside our competence. But we soon became convinced that the writers, if hostile to agnosticism and materialism,—we might almost venture to add "and to modern Science,"—are no less at issue with historical Christianity and with the teachings of the orthodox churches. We find here many startling assertions, to some of which we may refer in detail, and we naturally seek for their evidence. How have the writers learnt that which they set forth? Have they detected any phenomena, hitherto overlooked, from which their conclusions are legitimately induced? No; they seem to derive their doctrines from intuition. "The lectures," we are told on p. 4, "represent the results of Intuitional Memory, developed and otherwise assisted by the only mode of life compatible with sound philosophic observations." Now we will not deny the possible existence of "intuition as a faculty and a source of information," though we suspect that much of what is called intuition in man, and instinct in beasts, has a different source. But we ask, How can one man's alleged intuitions be evidence to another? How is B to know whether A's intuitions have anything but a pathological origin? How have the writers ascertained, and how can they prove, what modes of life are "compatible with sound philosophic observations"?

Among the strange opinions to be met with in this volume may be mentioned the following:—The planets are persons, possessing memory (pp. 8 and 9). Man is a fourfold being, composed of a material body, an "astral" body or "perisoul," a soul, and a spirit. Maimonides is quoted with apparent approbation for the dictum—"When thy senses affirm that which thy reason denies, reject the testimony of thy senses, and listen only to thy reason." Was therefore Maimonides the philosopher who, when told that facts were against his theories, calmly replied "So much the worse for the facts"?

On p. 15 we read—"Whether of the individual or the universal, Soul is Substance, that which sub-stands all phenomena. This substance is original protoplasm." It may here be remarked that a play upon words is a very prominent feature of this book. It should have been preferably written in the German language, which yields greater scope to such performances. We further find (p. 16) that matter and spirit are merely "two states of the same thing." Matter is "substance in its dynamic state.' The following passage, if we misunderstand it not, is put forward as an explanation of the origin of life:—"The soul's entrance into matter and primal manifestation as an individual occurs in the lowest forms of organic life, and is due to the convergence of the magnetic poles of the constituents of some protoplasmic entity, an action due to the working of the Spirit in the Matter concerned. For all Matter, it must be remembered, has and is Spirit. The focussing of these poles gives rise to a circular magnetic current, of which the result is an electric combustion, which is the vital spark, organic life, Soul."

Again, "The process of its (the soul's) generation is gradual. The magnetic forces of innumerable elements are directed and focussed to one centre; and streams of electric power pass along all their convergent poles to that centre until they create there a fire, a kind of crystallisation of magnetic force."

As a further specimen of the physics of this book we take the following (p. 48):—"Earth is the result of the water and the air, fused and crystallised by the action of the fire." Crystallisation of force; a crystal which is a fire; water and air fused are notions so strange that comment is needless.

On p. 20 we are told that between the organic and the inorganic there is no boundary line. The doctrine of Evolution is admitted, but with the qualification that it was "anticipated thousands of years ago." In seeking to controvert those who would explain the universe by the action of energy upon matter, the authors point to "the strong set of the current of life in the direction of beauty and goodness." Alas! to the unprejudiced observer the "set" runs exactly the other way. It is not, we think, foul weeds and noxious animals that are decimated by phylloxera and anthrax; it is not the rose, the vine, or the wheat-plant that spring up everywhere and choke out less noble plants; it is not the lovely and harmless bird or insect which is able to establish itself in strange climates.

To proceed: it is asserted that the lower animals are rudimentary men, and after a sufficient number of incarnations reach humanity. "Animals appeared first on earth, not, as is vainly supposed, to minister to man's physical wants, but as an essential preliminary to humanity itself." We may here remark that Modern Science fully rejects the notion that the lower animals exist to minister to man. But on p. 47 we find it stated—"And there were none of these (*i.e.*, creeping things) in the Age of Gold, neither shall there be any when the earth is fully purged. Man's own wickedness is the creator of his evil beasts. Again, on p. 75 we find the same idea substantially repeated:—"Wherefore it is an error to hold Nature responsible for fierce and horrible creatures. The mark set upon Cain has its counterpart in the stripe of the tiger; and the Crustacea denote selfish spirits who are hard exteriorly to all the world, and soft only interiorly to themselves." Now the authors apparently understand under "evil beasts" the Carnivora (*see* p. 165), and they put forward, as a problem in teleology, only to be solved on their principles, (p. 24), the existence of beasts in the long ages prior to the advent of man. But seeing that among those animals which flourished in the pre-human geological epochs many were carnivorous, the statement that man is the creator of such beasts is reduced to an absurdity. We might ask why the carnivorous animal alone is pronounced "evil"? It kills to eat, whilst vegetarian beasts—*e.g.*, the bull, the Cape buffalo, the black African rhinoceros, the keitloa, the peccary, &c.—will often attack man and other animals out of pure "superfluity of naughtiness." It has also been fully proved that whilst carnivorous animals in captivity become really attached to man, and show an affectionate disposition, deer, sheep, goats, &c., under the same circumstances, turn malicious as they reach maturity. This is a point of the more importance since the authors view flesh-eaters, human or brute, as the worst of offenders. In connection with this subject we must ask whether the authors, who allow of no hard and fast line between the organic and the inorganic world, would yet draw an abrupt boundary between animals and plants? If they do they are at variance with their own principles, as well as with the teachings of modern research. If they do not, then the destruction and mutilation of harmless and helpless plants must stand on the same "plane" as the slaughter of animals.

We must return to the transmigration of souls. If, as it is alleged, every animal is a rudimentary (or possibly a degenerated) man, and if every man has passed not racially, but individually, through the forms of the lower animals, it is an arithmetical necessity that the number of individuals in every species, or at least in every group, should be equal. If all earth-worms, all mosquitoes, all herrings are to become men, the number of individuals of each must not be greater than that of men. Now if we take the number of human beings in each generation at a thousand millions, each living on an average for thirty years, we must certainly reckon the mosquitoes in existence at any one time at many billions, with several generations each year. On the other hand, the total number of individuals among the Mammalia, if we except certain Rodents, is *less* than that of man. The same will be found the case with most groups of birds. This plain consideration, if fairly worked out, will we believe prove fatal to the doctrine of animals being the germs of future men. The authors, however, have judiciously abstained from sketching the ascending pedigree of humanity.

We regret having to proceed further. The work before us is not a mere collection of speculations which, if lacking evidence and incapable of being put to the test of sober experimentation, are certainly curious and possibly suggestive; it contemplates a social revolution wilder than was ever dreamt of by Nihilist or Communard. The chief points of this new Charter are "woman's rights" in the most exaggerated form, involving not merely equality, but the subjugation of the male sex, and, secondly, the emancipation of animals. This latter point requires certainly the abolition of the slaughter of animals for food, feathers, hides, &c. If we do not mistake the authors, the destruction of life in self-defence and the compulsory employment of beasts of burden will also be restricted. If such is not the doctrine of the writers consistency requires that it should be.

The work is absolutely saturated with the virus of anti-vivisectionism. We quote the following passage :—" The adept can see the human shape in creatures under torture in the physiological laboratory. He can discern the potential form of a man, with limbs and lineaments resembling those of his tormentors, hidden within the outward form, and writhing and moaning under the lacerations of the knife. And he sees also the tiger and the devil rapidly developing within the still human forms of the torturers." Who is to draw the boundary between the " intuitions " of such adepts or " epopts " and the illusions of the fanatic and the neuropath ? It would, we fear, be utterly useless to remind such morbid minds that nineteen-twentieths of what is called vivisection involves no more pain than that inflicted in the operation of vaccination, and that in many cases the " lacerations of the knife " are conspicuous by their absence. If they would admit the truth they must know that the total amount of death and pain inflicted upon animals in the cause of Science is but as the small dust of the balance. For one animal killed or pained in the pursuit of knowledge, thousands are slain or tormented in other causes, against which society raises not a whisper. Again, if we are not to eat animals we must extirpate them in self-defence. The struggle for existence, whether we accept it as an agent in the process of Evolution or not, is a stern fact, and it says to man, as to every creature, " destroy or be destroyed ! "

In one sense we may thank the authors : physiological experimentation will be safe if, as they propose, sportsmen, flesh-eaters, and dog-fanciers are expelled from the ranks of its enemies.

We fear this book will make many converts to agnosticism and materialism, doctrines which, however unsatisfactory, are clear, wholesome, and luminous as compared with the visionary mysticism taught in these pages.

Experimental Chemistry for Junior Students. By J. EMERSON REYNOLDS, M.D., F.R.S., &c. Part II. — Non-metals. London : Longmans and Co.

WE have here a small manual in which the principal facts and the laws of Chemical Science are taught successively in a series of experiments adapted to the capacity of junior students. The author begins with air and nitrogen. A knowledge of air is certainly important to the student, seeing that almost all chemical operations are performed in its presence, and the results are often modified in consequence of its action. But it may, we think, be fairly questioned by what right a substance admitted to be a mere mechanical mixture comes to be described among elementary bodies and their compounds. It might also be asked whether the first argument given to prove the air to be a mixture —viz., the inconstancy of its composition—can be taken as valid. It is conceivable that a definite chemical compound might be mixed with a variable excess of one of its constituents. In that case the ultimate analysis of the whole might fluctuate slightly, though we should be dealing with a compound somewhat contaminated.

The author observes that in tropical countries the oxygen of the atmosphere has been observed to drop suddenly as low as 20·3 per cent. This phenomenon, we understand, is not confined to tropical countries, but has been observed as far north as 40°, being attended by winds blowing in divergent directions from the place where the anomaly was recognised.

We are glad to note that the author calls attention to the true respiration of plants,—a process often overlooked in chemical manuals, because masked by assimilation of carbon. The reader is also taught that not all plants, but merely such as possess chlorophyll cells, are able to decompose the carbon dioxide of the air.

A very curious experiment here described is the liberation of hydrofluoric acid from pounded teeth,—say of sheep,—thus proving the presence of fluorine in the animal system and inferentially in vegetation.

The work may safely be recommended as clear, and it is scarcely needful to add accurate in its teachings.

A Systematic Handbook of Volumetric Analysis: or, the Quantitative Estimation of Chemical Substances by Measure, applied to Liquids, Solids, and Gases, adapted to the requirements of Pure Chemical Research, Pathological Chemistry, Pharmacy, Metallurgy, Manufacturing Chemistry, Photography, &c., and for the Valuation of Substances used in Commerce, Agriculture, and the Arts. By FRANCIS SUTTON, F.C.S. Fourth Edition, London: J. and A. Churchill.

BOTH volumetric analysis and the work before us have undergone noteworthy changes since the appearance of its first edition. Many procedures have been improved, many substances have been found capable of volumetric determination which twenty years ago were thought quite outside its scope. In certain cases—*e.g.*, the determination of sulphuric acid—it even appears that the gravimetric method is inferior in accuracy as well as in despatch, The volumetric analyses of gases, a subject not touched upon in the first edition, is treated at very considerable length in the one now before us.

Under the analysis of water we read that the method of estimating nitrogen as ammonia is substantially that described by the late W. A. Miller ("Journal of the Chemical Society" [2], iii., p. 125). We presume the author means to say "the method of estimating that portion of nitrogen which exists in water as ready-formed ammonia." The language he actually uses would seem to include the determination of organic nitrogenous matter according to the process of Wanklyn, Chapman, and Smith. It must also be remarked that the determination of pre-existing ammonia or ammoniacal salts by distillation with sodium carbonate, and subsequent "Nesslerising," is popularly ascribed to the three chemists just mentioned. The author expresses himself very confidently—too confidently we fear—as to the trustworthiness of the means of determining the organic impurities in potable waters described in his Part VI. We are unable to share this confidence, and think that, so far at least, no perfect process for water-analysis has yet been devised. We know at least one signal instance where two identical samples of water, or rather two portions of one sample, on being sent through distinct channels to a very eminent chemist, gave results widely different, but in strict accordance with that chemist's known predilections. No chemical test seems capable of showing if nitrogen, whether determined by combustion or by conversion into ammonia, has been derived from a deadly or an innocent microbion. Water absolutely and permanently free from organic nitrogen is not found in Nature, and it is quite conceivable—or rather it is probable—that the sample containing the smaller quantity may be, from its quality, the more deadly. If we may venture to suggest, the water analysis of the future will turn more on microscopic examination and on "culture" experiments than on strictly chemical procedures. But progress in this direction is for the present barred to English chemists and physiologists. We do not see that the "hydrosulphite" process—the determination of the quantity of free oxygen present in any sample of water by means of the hydrosulphite solution of Schützenberger and De Lalande—is mentioned. This process is certainly practicable, but whether the free oxygen varies in regular inverse proportion to the organic impurities requires further examination. Our own observations leave the question doubtful, and we look forward with much interest to the results of others.

One of the changes which volumetric analysis has undergone is the substitution of atomic standard solutions for those called empirical. We are not sure that this change is in all cases an advantage. There is a very considerable convenience in the use of solutions such that the number of degrees read off in the burette shows at once, without any calculation or reference to theories, the percentage of the body sought,—*e.g.*, of metallic tin in a sample of tin crystals. We fully admit that, to an analytical chemist in general practice, the atomic system has the tangible advantage of requiring a much smaller stock of standard solutions. But for a manager or foreman of some department in a chemical manufactory, who has to repeat say one or two determinations continually, we are old-fashioned enough to prefer the empirical system.

We find in Mr. Sutton's present edition a careful notice of the new alkalimetric indicators which have been introduced, with more or less success, in place of litmus. He gives the preference to Poirrier's "Orange 3," as being entirely unaffected by carbonic acid or sulphuretted hydrogen. Hence by its means samples of soda-ash, &c., can be titrated in the cold. Ammonia, also, does not interfere with its action, a merit not shared by phenol-phthalein.

Taken as a whole Mr. Sutton's work has no rival in the English language, and the present edition, being a distinct improvement on its predecessors, will give correspondingly greater satisfaction.

Magnetism and Electricity. An Elementary Text-Book for Students. By R. Wormell, D.Sc., Head Master of the City of London Middle-class Schools. London: Thomas Murby.

The production of a good elementary text-book in any department of Science is no easy task. The fullest knowledge of the subject-matter is, in itself, far from sufficient. There is also required an acquaintance with the art of presenting subjects to the mind of the pupil. Hence we are beginning to find that such manuals should be written by men who, in addition to the requisite scientific mastery, possess the experience of the practical educationist. The treatise before us is drawn up from this double point of view. In the outset it makes exceedingly small demands upon the pupil's knowledge; but by a series of experiments, at first exceedingly simple and easy, he is gradually led to a comprehension of the principles of electricity and magnetism, and to an understanding of natural laws.

We note with pleasure that the book—or rather the course of teaching for which the book serves as manual—is distinctly intended to be practical. The lecture experiments given in the text are to be repeated by the student, and as he advances he is gradually introduced into the practice of the physical laboratory. Thus he will become not a mere reader, but a worker in Science, and, if his opportunities and faculties allow, he may finally stand forth as a discoverer or an inventor.

The author seems to recognise the great truth that Physical Science is needed in education for the discipline of the hand and the eye,—objects for which the utter impotence of classical and mathematical studies must be at once admitted. By discipline of the eye Dr. Wormell evidently means training in the art of observation—a point till lately completely overlooked in English education, primary as well as secondary. Admitting that different branches of Physics may serve equally well as agents of mental discipline, he thinks that electricity has peculiar claims and exceptional advantages, from the hold which it has recently obtained upon the attention of the general public, and from the important applications which it has recently received. However little a man's duties and tastes may bring him in contact with what are called scientific subjects, he will find it unpleasant to be ignorant of such inventions as the telephone, the microphone, Faure's accumulator, &c. It is scarcely too much to say that a person to whom these novelties are unknown or unintelligible will find himself as much perplexed in modern society as would a man ignorant of Greek and Latin in the days of incessant classical quotations.

From its clearness of exposition and arrangement, as well as from the fulness and systematically progressive character of the experimental evidence set forth, we feel warranted in giving this work our warm recommendation. The chief deficiency we note is in the index. A person running his eye over it might be led to the mistaken conclusion that, *e.g.*, Geissler's tubes, Wheatstone's bridge, and other recent devices, had been overlooked.

CORRESPONDENCE.

*** The Editor does not hold himself responsible for statements of facts or opinions expressed in Correspondence, or in Articles bearing the signature of their respective authors.

"HAUNTED HOUSES."

To the Editor of the Journal of Science.

Sir,—I used to read with a friend, a medical student in the surgery, after business hours, and at times indulge in a little private dissection upon small subjects. While so engaged one night we were startled by the private surgery bell, upstairs, being very violently rung. There being only the old housekeeper in the house except ourselves, and she had gone to bed some time, we were puzzled to account for it, as of course there was no one in the room when we went in. This went on for several nights, and always between 12 and 1 p.m.

Not believing in ghosts we determined to watch, one upstairs and one down. Nothing occurred for some time; the bell-ringing stopped. At last one night while my friend, who was upstairs, was watching, he saw several mice come out of a hole and run along the wire which ran across the passage-wall, thus causing the wire to vibrate the bell.

Our work, the time, and regularity with which this occurred, would have made it a good case for a haunted house if the cause had not been discovered.—I am, &c.,

A. J. D.

35, Lewisham High Road, New Cross,
February 26, 1882.

CRUELTY TO ANIMALS.

To the Editor of the Journal of Science.

Sir,—At the request of my friends I write to correct you—if, indeed it be worth while—in regard to the error under which you appear to labour concerning my opinions and practice. Had your critic cared to enquire on the subject, he would easily have learnt that, having been for twelve years a vegetarian, and a well-known writer against every phase of cruel sport, as well as against feather and fur wearing,—which articles I never buy for myself under any pretence,—his strictures on my supposed inconsistency fall very wide indeed of their mark. Your critic will do well to buy, beg, or borrow my little book entitled "The Perfect Way in Diet," wherein he will find arguments and pleadings galore against slaughter-houses, bird-trapping, seal-hunting, leather-wearing, and all other mal-practices in regard to animals. And, for the future, let him acquaint himself with the truth about those whom he assails before laying to their charge "things that they know not."—I am, &c.,

ANNA KINGSFORD, M.D.

The above communication, which we print as a curiosity, cannot be more truthfully and more severely characterised than as typically anti-vivisectionist, at once in its tone and in its line of assertion. Mrs. Kingsford, M.D., of whose very existence—not to speak of her "opinions," her "practice," and her writings—we were not aware prior to her recent outbreak in "Light," is not pronounced personally inconsistent, and hence her letter is simply an impertinence. If the lady in question makes use of beasts of burden, even without the bearing-rein, she is party to a custom involving more pain and "cutting up alive" than does physiological research. If she eschews animal food, "sport," fur and feather wearing, and the use of leather, her fellow-agitators and the public whom she is trying to influence do not. Hence the movement against experimentation on animals is inconsistent, and has logically no *locus standi*. Yet we do not see that Mrs. Kingsford called attention to this truth, or exhorted her hearers to quit their glass houses before beginning to throw stones. As our critic has not departed by a hair's breadth from that fairness which we have always endeavoured to observe even to anti-vivisectionists, we decline on his behalf the advice so naïvely tendered. Our readers may as well be informed that our correspondent is a believer in metempsychosis. She is reported in "Light" to have recently said that "she was beginning to recollect her former incarnations, but they were not such as she would like to make public. One of them filled her with shame and horror whenever she thought of it." Perhaps, if her belief is well founded, she will in some higher state of existence look back upon her anti-scientific orations with little complacency.

THE EDITOR OF THE JOURNAL OF SCIENCE.

EVOLUTIONIST VIEWS OF BEAUTY.

To the Editor of the Journal of Science.

Sir,—Your contributor Mr. Ram, in his attempt to account for our sense of beauty on Evolutionist (or rather on Natural Selectionist) principles, remarks—"The love of mountain scenery which some men possess records the fact that their ancestors were benefitted by such a taste which led them to dwell in localities least accessible to the foe." How does the writer, then, account for the fact that the love of mountain scenery is very modern in its origin, and is rapidly increasing, whilst if we look back even a couple of centuries we find mountainous regions pronounced dismal, desolate, and horrid.—I am, &c.,

Doubter.

Sir W. Thomson's communication in our next.

NOTES.

M. E. de Cyon ("Comptes Rendus") has examined the influence of high atmospheric pressures upon animal life. He finds that they modify sensibly the normal relations of the tension of the gases contained in the blood. This action is exerted upon the circulatory and respiratory systems. Pure oxygen is not a special poison for the organisms, and animals die in it because the carbonic acid (the chief excitant of the vasomotor and respiratory centres), being sensibly diminished, the circulation and respiration are arrested. The movements of the heart are quickened at first because the oxygen (the normal excitant of the nerves and the accelerating centres) augments their activity, whilst the absence of carbonic acid diminishes the moderating action of the pneumogastric nerves.

M. C. Gessard ("Comptes Rendus") finds that the blue and green colouring-matter which sometimes appears on the dressing of wounds is due to pyocyanine, which on oxidation passes into a yellow, pyoxanthose. Pyocyanine, like the ptomaines, reduces potassium ferricyanide.

M. Bjerknes and M. Decharmes have both succeeded in imitating electric action hydro-dynamically. The former, by means of bodies vibrating in water, reproduces the phenomena of static electricity and of magnetism inversely. The latter, experimenting with liquid currents, finds a direct analogy between hydrodynamic phenomena and those of electro-magnetism and induction.

M. Laveran some time ago discovered on the blood of ague-patients a peculiar microbion, *Oscillaria malariæ*. M. H. Richard, in a communication to the Academy of Sciences, traces the development of these parasites, which live in the red blood globules and destroy them.

Mr. Grant Allen ("Fortnightly Review"), in a notice of the autobiography of Sir C. Lyell, makes the following happy remarks:—"He luckily escaped the conventionalising and stereotyping drill of our public schools: he was never put through one of those dismal mills for crushing out individuality into which we turn most of our best material, so as to grind it down to the Procrustean measure of Ovidian elegiacs and Eschylean trimeters. . . . He was spared the brutal influence of 'compulsory foot-ball' which would have been substituted for the pursuit of Nature in a modern public school." We regret that Mr. Grant

—perhaps in compliment to the *genius loci*—should have thought fit to season his otherwise admirable article with party politics.

The "Psychological Review" gives a remarkable "ghost story," but without the details which would be required for its verification. This "Review" also shows very prominent political leanings.

Dr. Nagorski has measured the capacity of the lungs of 630 boys and 314 girls in the schools of St. Petersburg. The volume is in boys 65 c.c. per kilo. of the weight of the body, and in girls 57 c.c. The weight of children under 15 years is proportional to 2·15 of the height.

Mr. Herbert Spencer, long forgetful of the maxim that the philosopher's position should be "higher than on the battlements of party," has at last formally come forward as a political agitator. Perhaps thinkers in thus acting are swayed by the same motives which lead the "minister of all denominations" to turn sensationalist, and the pharmaceutist to vend quack medicines and cigars. Nevertheless they are thereby committing suicide. Agitations and "movements" are to discovery and research what the *Phylloxera* is to the vine.

Dr. W. Flight ("Geological Magazine") gives some instances of meteorites which have been found intensely cold on falling.

Miss M. A. Hardaker ("Popular Science Monthly") shows on physiological grounds, that the difference of intellectual power in the two sexes is due to permanent conditions, and not to artificial arrangements.

W. D. Le Sueur ("Popular Science Review") writes—"Before we could affirm grossness or anything else of matter, we should have to get some of it and compare it with something that was not matter, but which yet could be legitimately compared with it.

F. Hildebrand ("Das Ausland") shows that annual plants are most numerous where a fairly long hot season alternates with a cold one. In equatorial regions, and the sub-arctic and arctic zones, the vegetation is chiefly perennial.

MM. Dehérain and Maquenne ("Annales Agronomiques") find, from repeated experiments, that the growth of plants—*e.g.*, in conservatories—may be accelerated by means of an atmosphere abnormally rich in carbonic acid.

H. A. Pagenstecher, in a discourse on the Cervidæ delivered before the Natural History and Medical Association of Heidelberg, pronounced that family a model field for the study of descent and adaptation.

Drs. Reynard and Blanchard (Société de Biologie) have measured the power of the masseter muscles of the crocodile as compared with those of the dog. The latter exerts a power of 8·25 kilos. per kilo. of its own weight, while in the crocodile the power exerted rises to 12·8 kilos.

M. Lecoq de Boisbaudran has exhibited to the Academy of Sciences a specimen of a curious violet colouring-matter developed on the surface of starch-paste, especially if exposed to the vapours of acetic acid.

M. Filhol ("Comptes Rendus") concludes that Campbell Island has never been in connection with New Zealand, its fauna, present and fossil, being totally distinct.

It is stated that during the recent season of high barometric pressure the sea-level was depressed about a foot at Antibes, and continued so for a fortnight. On the summit of the Pic du Midi temperatures as high as 68° to 69° F. were registered from January 8th to January 20th. During the exceptional calm in England and France, the north of Norway suffered from unusually violent and continued tempests.

An instrument closely approaching the telephone is said to have been invented in the seventeenth century, by one Grimmelshauen, a soldier in the service of the Bishop of Strasburg.

Believers in metempsychosis would do well to examine whether their supposed recollections of prior lives are not simply cases of hereditary reminiscence.

M. Vulpian ("Comptes Rendus") criticises the views of M. de Lacerda on the value of potassium permanganate as an antidote to snake-poisons. He shows that the bite of *Bothrops Jacarandi* in Brazil is not always deadly; he proves that the injection of a solution of permanganate into a vein is fatal, and that if it merely passes into the subcutaneous cellular tissue it will be decomposed, forming a clot of hydrated peroxide very near the point of injection, and being thus prevented from penetrating far. The poison, on the other hand, is not thus decomposed. He does not call in question the alleged character of the poison as being not a true chemical agent, but a ferment.

In the introductory chapter of the "Manual of the Infusoria," by W. S. Kent, now in course of publication, the following appears, and should certainly be made more public than it is likely to be as a mere footnote in a very extensive work:—"In association with the discoveries of Leeuwenhoek here recorded, it is worthy of remark that a cabinet of the microscopes, to the number of twenty-six, as self-constructed and employed by that investigator, and consisting of simple doubly-convex lenses, were originally presented by him to the Royal Society of England, but have long since been lost sight of. The latest tidings of them would appear to have been furnished by Mr. Henry Baker, who in his work 'The Microscope made Easy' [p. 7, note], published in the year 1785, attests to having had these glasses under examination away from the Society's premises, and at his own private residence. The recovery of such precious heir-looms, and the reconsignment of the same to their former custody, or among the series of optical instruments belonging to the Royal Microscopical Society, where perhaps they would be even more highly prized, is a consummation most devoutly to be wished, and may possibly be helped forward by this notice." The microscopes and their accompanying apparatus, as made by Leeuwenhoek, are described in Hoole's translation of his works, vol. ii., p. 217, and figured on plate 17.

Vivisection and Cynolaters.—We extract the following paragraph from the "Medical Press and Circular":—"An attempt was made on Saturday last, by Miss F. P. Cobbe, to depose Mr. G. Fleming, President of the Royal College of Veterinary Surgeons, from his seat on the Committee of Management of the 'Home for Lost and Starving Dogs.' The reason alleged was that Mr. Fleming had published an article in demonstration of the benefits conferred on animals themselves by vivisection. We can quite understand the bitterness with which anti-scientific enthusiasts regard the rapid growth of public opinion in favour of vivisection, since the attempt has been made to put the real state of the case before the world by qualified authorities. Of course the amendment proposed by this lady was ignominiously defeated."

The following remarks taken from a contemporary, though more especially levelled at pharmaceutical examinations, are true in a far wider sense:—"To get through is the main thing; not the possession of much knowledge. Private study is not of much use. It is too lengthy, and a man actually studies too much. A cramming school is the thing, where the ass is soon able to roar like the lion."

Prof. Marsh is criticised in the "American Naturalist" for failing, in his work on the classification of the Dinosauria, to recognise the labours of others and to credit others with their own discoveries. He assigns to Prof. Huxley the merit of showing the bird-like affinities of the Dinosauria, though this had been done at least a year earlier by Prof. Cope.

We regret having to record the premature death of Sir C. Wyville Thomson, late Professor of Natural History at the University of Edinburgh, and Chief of the Scientific Staff of the *Challenger* Expedition. Though nearly six years have elapsed since the return of the Expedition, the task of arranging the multitudinous specimens and drawing up the reports has not been completed. The deceased, who was only 52 years of age, had held successively professorships at Aberdeen, Cork, and Belfast, and had been engaged on the dredging expeditions of the *Light-*

ning and *Porcupine* before his appointment at Edinburgh. His contributions to the Transactions of learned societies are numerous and important. Whilst paying our last tribute to the memory of this indefatigable worker in Science, we cannot refer without pain to the unseemly character of the dispute concerning his successor. It appears that what is locally known as "soundness" is considered of greater weight than merit and efficiency.

M. A. Raffray ("Comptes Rendus") gives a view of the geographical distribution of Coleoptera in Abyssinia. In the littoral zone, an arid plain, the Coleoptera belong almost exclusively to Saharian types, the Tenebrionides predominating. In the interior valleys the types are Senegalian. Among the characteristic forms are *Tefflus*, *Galinta*, *Casnonia*, *Heliocopris*, many Cetoniadæ,—including *Goliathus Pluto*, *Eudicella Chloe*, and *Campsocephalus Horsfieldianus*,—some fine Buprestidæ, Cerambycidæ, and a great variety of Chrysomelidæ. On the table-lands most of the Coleoptera are peculiar; some have analogies with Natal, and some with the Mediterranean basin. There are few Longicornes, Buprestidæ, and Cetoniadæ, but many dung-feeding Lamellicornes and Carabs, many of the latter analogous to those of Syria and Southern Europe. In this zone there are numerous Paussides. In the fourth or subalpine zone the predominant forms are distinctly European, the chief exception being an aberrant *Calosoma* (*C. caraboides*). Among eighteen mollusks from the same zone nine belong to African and nine to European types.

Prof. Schmich ("Naturforscher") attributes, like Adhemar, the changes in the land- and sea-level to alternations in the latter affecting the northern and southern hemispheres in semi-periods of 10,500 years. The more flooded hemisphere has its glacial epoch, with an oceanic climate; the less flooded has its warm epoch, which is approaching in the northern hemisphere.

M. S. Jourdain ("Comptes Rendus") shows that in the starfishes the supposed heart and the vascular circles are merely the genital passages and annexed glands.

M. Marey ("Comptes Rendus") announces that he has succeeded in reproducing photographically the successive movements of a bird in flight. With a specially modified apparatus he is able to take twelve successive images per second—the time required for each being from 1-700th to 1-1500th of a second, according to the weather.

J. Reinke ("Berlin Berichte"), in replying to HH. Loew and Bokorny (*see* "Journal of Science," 1882, p. 152), contends that protoplasm is not a "body" in the chemical sense of the word, but an organism. He also shows that the reducing power is no fundamental and universal difference between living and dead cells, since it is wanting or doubtful in animal cells, the cells of Fungi and of the roots of *Pisum* and *Zea*.

M. Fischer gives ("Petermann's Geograph. Mittheilung.") an essay on the distribution of the date-tree. It can bear a winter temperature as low as 23·9°, and even the contact of snow for a day or two. To ripen its fruits it requires a mean summer temperature of at least 79° F., a dry air, and a clear sky. Its northern limit as a fruit tree is given by the isotherm of 70° F., and as an ornamental tree by that of 61° F.

"Ciel et Terre" describes the showers of dust so common in Italy. They occur generally in calm weather after a sirocco. The sky takes a reddish tint, the barometer falls, and the temperature rises. The dust is of a brick-red colour, of an acid reaction, and contains iron, partly of terrestrial and partly of cosmic origin. If accompanied by rain it injures vegetation by its causticity.

Mr. J. A. Wanklyn, writing in a lay paper, impugns the validity of the scientific evidence in the Lamson case.

Out of every hundred anti-vivisectionists ninety-nine are quite willing to get rid of vermin by poison. But if vermin are poisoned to solve an important judicial question, as in this very Lamson case, we hear shrieks about "violationism," "orgies of diabolism," and the like!

M. Decharme ("Comptes Rendus") has succeeded in reproducing, by means of liquid currents, the coloured rings of Nobili as obtained by electric currents.

Diphtheria—a disease which, by the way, according to the "New York Medical Record," may be communicated by cats—has been ravaging Bloemfontein, South Africa. Many cases proved fatal within twenty-four hours.

In the Department of the Seine there have been, from November 1st, 1880, to November 1st, 1881, 641 cases of rabies in dogs: 153 persons have been bitten, of whom 21 have died of hydrophobia.

An American contemporary suggests that the navies of all powers might, in time of peace, contribute much to scientific exploration without any sacrifice of efficiency and without appreciable outlay.

Dr. Brown-Sequard ("Comptes Rendus") shows that in the guinea-pig the results of accidental post-natal lesions may be transmitted for several generations.

Dr. J. F. Snyder ("Kansas Review of Science") contends that the mound-builders and miners of North America were not a distinct and vanished people, but were of the same race as the Aborigines found by the first European settlers.

ERRATUM

Footnote at bottom of p. 148, *for* "insignificant" *read* "significant."

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I. THE IDENTITY OF VITAL AND COSMICAL ENERGY.*

> "The question of questions for mankind . . . is the ascertainment of the place which Man occupies in Nature, and of his relation to the Universe of things."—Prof. HUXLEY, *Evidence as to Man's Place in Nature.*

THE history of human thought is the history of two rival philosophies. Arrayed in various disguises, linked with widely differing methods of investigation and inference, sometimes appearing for a moment to meet and coalesce, but quickly starting back from the uncongenial embrace, Materialism and Idealism have for ages maintained a separate hostile existence. Yet no Materialist has succeeded in refuting the logic of Idealism, while every Idealist has practically assumed the real existence of Matter. Idealism has been in the position of a constitutional monarch, whose title is sure, but whose power is non-existent; while Materialism has resembled an irresponsible popular ruler, insecure yet all-powerful. But, if we cannot think without acknowledging one system, and cannot act without assuming the other, it will be wise to search for some logical bond of union between the two; and should we succeed in discovering actual unity beneath seeming disunion, the resulting synthesis may be entitled Hylo-Idealism, or the somatic *rationale* of the subjective and objective Universe. Here are the two main pillars which support the fabric of life and thought: let us see whether they do not rest on the same foundation. The little work before us may prove a valuable aid in the solution of this momentous problem.

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* Life and Mind on the Basis of Modern Medicine. By ROBERT LEWINS, M.D. London: Watts and Co.

In the present day no man possessing any acquaintance with the mechanism of the sensory organs can completely ignore the phenomenal or ideal theory. Its truths are forced upon him, whether he will or no; and at the end of his researches he is compelled to admit that his experiments upon those phenomena which he calls muscle and nerve have really been experiments upon varied modifications of his own consciousness. He finds that the nervous excitations which produce sensations so diverse as those of sight, hearing, taste, smell, and touch, are all essentially the same during their journey from the receptive organ to the brain. In every case a special apparatus receives a special impulse, which it transmits to a special region of the cerebrum; but the difference which exists between incident waves of light and sound, and impressions of touch, smell, and taste, is lost during transmission. When the motion thus propagated arrives at its terminus in the encephalon, it excites the sensation peculiar to that group of nerve-cells which is affected; but the mode of vibration which was communicated to eye or ear is not necessarily reproduced, and can obviously have nothing in common with the subjective phenomenon. "Supposing that the nerves of hearing and of sight of a man were cut, and the peripheric end of the former were perfectly united with the central end of the latter, and contrariwise that the peripheric end of the nerve of sight were perfectly united with the central end of the nerve of hearing, then the sound of an orchestra would elicit in us the sensation of light and colour, and the sight of a highly-coloured picture would elicit in us impressions of sound. The sensations which we receive from outward impressions are therefore not dependent on the nature of those impressions, but on the nature of our nerve-cells. We feel not that which acts on our bodies, but only that which goes on in our brain."* Idealism is thus irrevocably established; yet we must warn the opponents of Materialism not to indulge in premature exultation. All knowledge is derived from phenomena; but the existence of an independent proplasm or matrix of phenomena is not therefore disproved; and if it be a necessary postulate, without which both psychical and physical science are empty delusions, we must accept this unknown Matter as the basis of our ideal

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* Muscles and Nerves, by Dr. J. ROSENTHAL, p. 283.

Cosmos. That this is the case has been shown in a previous paper,* where it is argued that this primary truth is involved in the assumed validity of reason and experience. Science has led us to Idealism; we are therefore bound to listen to the testimony of Science in support of the rival theorem.

The scientific diviner of past and future can, in the nineteenth century, scarcely be an absolute sceptic. What is really meant by the geologist who deciphers the unwritten records of a period when Earth was literally "without form and void," since there was no eye to receive the rays of light and transmute them into form and colour; by the astronomer who reveals the secrets of Heaven in ages yet more remote, and sees in imagination that molten and swiftly rotating terrestrial mass which could never have been an actually present phenomenon to the brain of man or beast? Phenomenal existence is in both cases clearly out of the question; for we cannot suppose that elaborate theories of cosmical and organic evolution depend on the hypothetical assumption of an Infinite Mind, in which is formed a continuous and eternal picture of the material universe. Evidently both astronomer and geologist mean to imply that Matter existed long before any known mind, and that the reality of its existence is in no way affected by the presence or absence of a percipient. The science and art of Medicine are founded upon the same postulate. Every physician is certain that the conscious or unconscious body upon which he exerts his skill is something more than a spectral figment of his own imagination; for by its means he hopes to evolve Cosmos from Chaos in the subjective universe of his patient. He knows that muscles, nerves, and skeleton owe that visible and tangible conformation which he perceives to the creative power of his own organs of sense; but he does not assume the arrogant *rôle* of sole and unconditional Creator. When he leaves the bedside the phenomena which were formed in his brain will disappear; the unperceived and independent reality will still remain. The very operation of his drugs is secret, but none the less sure.

It is therefore needless to insist further upon the real existence of Matter, which is taken for granted by all sane and practical men. But it may be doubted whether this simple postulate affords sufficient foundation for a consistent theory of life and mind, unless supplemented by the invocation of some super-sensuous and super-ideal entity. Is that which we call Mind an independent spiritual substance, or is it simply the outcome of certain changes in the grey matter of the encephalon? Here, when we remember the "sensifacient" power of our sensory ganglia, there seems but small ground for dispute; yet we may as well see whether the advocates of Dualism can produce any reasonable argument in support of their heresy. We will take as our text the main thesis enunciated by Dr. Lewins, viz., "the all-sufficiency of Matter to carry on its own operations, and the consequent non-necessity of a vital or spiritual principle as an entity apart from the inherent energy of the material organism," and we will examine the evidence which may be adduced for and against such a thesis.

---

* "Animal Automatism," by C. N., in the Journal of Science, April, 1882.

The old *à priori* argument, that Matter, being essentially inert, cannot originate force, falls to the ground before the discoveries of modern Physics and Physiology. It is, indeed, founded upon two baseless assumptions, one of which is sufficiently refuted by Newton's formula of Universal Gravitation, and the other by modern anatomical investigations and reasonings from the observed effect of stimulants, &c., and of cerebral disease or injury.

The first fallacy, or the doctrine of inertia, has long ceased to be an article of scientific faith, and is relegated to a limbo peopled with such ghosts as the phlogiston theory and Nature's horror of a vacuum. Newton's first law of motion, the very proposition chiefly relied upon as expressing and formulating this lack of automatic energy, really goes to prove that motion is a condition of matter not less natural than rest.* A body completely isolated for all eternity in a boundless vacuum would either remain at rest for ever or would move uniformly in a straight line. Either event would be equally natural; for the origin of equilibrium stands in quite as much need of explanation as the origin of movement. The former may, indeed, be represented as the resultant of two or more opposing and equally balanced forces, or, in the words of Sir John Herschel, as "a continual production of two opposite effects, each undoing at every instant what the other has done." The latest theories respecting the constitution of matter require us to regard every molecule not merely as attracting, and thus moving or holding firm other molecules, but as itself in a continuous state of vibratory or rotatory agitation. Cohesion therefore represents a condition not of rest, but of intense activity.

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* Newton's mystical statement in his letters to Dr. Bentley—"It is inconceivable that inanimate brute matter should, *without the mediation of something else which is not material*, operate on other matter"—is a proposition virtually *unthinkable.*

Could any material particle suffer a momentary loss of energy the seemingly passive mass of which it formed a part would become visibly active, and the forces hitherto counterbalanced would immediately assert themselves. Yet this increase of apparent action would be the effect of a decrease in real power. It appears, then, that force or energy is an inalienable attribute of matter, and that the momentary suspension of this *vis insita* in any part of the universe must necessarily result in a world-destroying catastrophe. But as cosmic energy is inseparable from the material cosmos, we have obviously no right to invoke a spiritual agent for its production, unless we are prepared to isolate other properties, such as impenetrability and extension, and to place each under the charge of a special Archæus.

Our external Universe is, however, if not inert, at least for the most part unconscious. How can this deaf and blind and senseless dust ever bud into even the lowest form of mind, far less blossom into the ideal glories of the philosopher and the poet? This objection loses its weight when we remember that the real problem to be solved is not—Can Matter think? but—Does Matter think? We reason on an entirely false method when we seek to invalidate conclusions derived from observation of living organisms merely because observation of inorganic matter does not yield all the data upon which such theories are founded. A particle of dust possesses various sensible qualities. It affects our senses of touch and sight in a special manner; it attracts and is attracted by other particles. But the several kinds of energy which it exerts give us no *à priori* reason to believe that some or all of its constituents will at any future time be recombined in a living and thinking brain-cell; nor will our closest examination suffice to discover any sign of such a destiny. Now statements such as this, not unfrequently dwelt upon by Dualists, are distinguished by perfect truth, but also by perfect irrelevance. We can only convince ourselves that Matter can think, by the observation of thinking matter. To infer that a nerve cannot feel because a straw is insensate, is as absurd as to conclude that, since ice makes us feel cold, boiling water cannot make us feel hot. In both cases there is a graduated scale between the two extremes, represented in the latter by a regularly intensified heat-quiver, in the former by a slowly increasing complexity of organisation, from which are at length evolved the first faint and doubtful rudiments of consciousness.

It seems now scarcely necessary to do more than mention the second fallacy with which we have to deal. This is involved in the idea that the vital energy manifested in what are called spontaneous acts is independent of any antecedent cause. A non-vital body, it is said, never moves except in consequence of some impulse communicated from without. Even though its separate particles be unresting, the entire mass needs some external stimulus to disturb its equilibrium. But this is not less true of organic and living matter, whose motions invariably depend upon external stimuli, although the connection is not apparent to a merely superficial observer. A person who had never seen a clock wound up, or who had not learnt to associate the process of winding with its usual results, might imagine that ticking and striking were spontaneous actions, solely dependent on the will and pleasure of the timepiece. In the same way, a person wholly unacquainted with physiology fails to connect the functions of nutrition and respiration with the functions of thought, sensation, and voluntary motion. Yet it is not more certain that a clock will stop if not wound up, than that the human mechanism will cease to work if not supplied with food and fresh air. Even an action which seems perfectly free and uncaused is the last term of a succession of internal changes which had their beginning in some impulse from without. When the impulse is spent the changes will cease. But the functions of the clock depend on its original structure not less than on the periodical winding up. From one point of view every tick may be regarded as due to the tools and hand of the clock-maker; from another, to the key which winds it up once a week. In the same way, the energy which displays itself in perception and volition may be ascribed to the daily transubstantiation of food, drink, and oxygen; or it may be traced in imagination to the pre-natal period, or even followed yet farther back through a long line of slowly-developed ancestral forms. From any point of view the influences concerned in its production or evolution have been purely somatic.

Just as the forces which operate in a living cell cannot be essentially different from those which sustain the entire body, so the identity of vital and cosmical energy is conclusively proved by the constant interchange of matter—and consequently of material force—which takes place between that body and its environment. Man is to the circumambient world as a blood-corpuscle to the organism of which it forms a part. It possesses no vitality distinct from that of its Cosmos, the body, where its life as an individual cell begins and ends; yet it moves with apparent freedom, giving and receiving nutriment, and (in the case of the white corpuscles) exhibiting independent contractile power. The alchemist and charlatan Paracelsus taught that Man is a complete homologue of the Universe, and that all the celestial and terrestrial motions are repeated in the narrow compass of his corporeal frame. What is true of the little inner world, he argued, must therefore be true of the great outer world, so that Microcosm and Macrocosm mutually explain each other. This mystical doctrine, springing from a false theory of physics, and productive of innumerable absurdities, yet contains a seed of truth. Man is indeed an integral part of cosmic physiology.

Many will readily allow that what is called "animal life" needs no spiritual entity for its production and support, but will hesitate to assign a material origin to our intellectual and moral faculties. Yet it has been proved by experiment that an appreciable amount of heat is evolved by cerebral, just as by muscular, action; so that were our instruments sufficiently delicate, and our estimation of mental effort sufficiently exact, it would be possible to assign an equivalent in units of heat to every expenditure of intellectual force. This shows that thought is not less intimately connected with modifications of cerebral tissue than motion with modifications of muscular fibre. Thought is indeed the result of that slow combustion set up in the grey matter of the encephalon by the capillary circulation of blood from the lungs, just as contractility is the result of combustion in the muscles, and secretion of combustion in the liver and other glands. Not only does the vital machinery stop if the circulation in the brain be suspended, but its action can be temporarily restored after apparent death by injections of oxygenated blood. The head of a dog separated from the trunk has been thus for a moment revivified, so that when the animal was called by name its eyes turned in the direction of the familar sound.*

Life, like cohesion, is thus proved to depend upon a special adjustment of material forces. When one of these is disturbed, equilibrium is lost; and if this disturbance can be rectified, equilibrium is regained. It is well pointed out by Dr. Lewins that the ancient *rationale* of "suspended animation" is practically inconsistent with the efficacy of those "mechanical means of treatment successfully employed for the restoration of the apparently dead. Where matter is held to be essentially inert, a vital principle, an animating spirit, *must* be assumed, which in syncope, asphyxia, or death, deserts—either temporarily or finally—its material tenement, to emigrate as an indestructible, veritable entity elsewhere."* Now since we can, under certain circumstances, restore life by the re-establishment of its material conditions, it is evident that we have to deal not with a spiritual entity, but with a delicate and easily deranged mechanism. It is true that if too long a time is allowed to elapse before restorative measures are applied, the repair of the machine becomes impossible; but this arises from the intimate relation of its minute and complicated parts. Every change in the organism sets up a multitude of other changes, which progress so quickly that the whole soon becomes irreparably disintegrated.

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* The Brain and its Functions, by Dr. J. Luys, p. 69.

Anatomical and clinical observations in cases of mental disease, as well as experiments upon the living brain of the lower animals, point to the same conclusion. In the article by Drs. Tuke and Gibson, in the ninth edition of the "Encyclopædia Britannica," Insanity is described as "a chronic disease of the brain, inducing chronic disordered mental symptoms,"—a definition possessing "the great practical advantage of keeping before the student the primary fact that insanity is the result of disease of the brain, that it is not a mere immaterial disorder of the intellect." That barbarous treatment of the insane which still lingered in England and France during the early part of the present century is closely connected with the ancient doctrine of demoniac possession; and so long as Dualism continued to influence scientific practice, it is obvious that no efficient or systematic remedial measures could be adopted. The alienist medicine of Ancient Greece and Egypt, like that of our own time, was founded upon a materialistic basis: and we are but just awaking from the cruel mediæval dream to that light of day which was discerned—clearly, though far less brightly—by Hippocrates and Galen.

Mental pathology is now in a position to take vengeance for its long neglect by laying bare those morbid physical conditions which give birth to the mystical hallucinations of apostles, martyrs, prophets, and founders of Religions. We may fairly contend that all recorded celestial visitations "belong to the very alphabet of medical science, and may be confidently diagnosed as not preternatural occurrences at all, but merely symptoms of over-excitement—the result either of anæmia or hyperæmia—of the nervous centres in the head. Just as demoniacal possession is manifestly merely a disordered condition of the organism, so are Divine possession, inspiration, prophetic fury, and such phantasmata as Belshazzar's vision, and the apocalyptic sights and sounds of seers and second-sight wizards of every race and clime, from Ezekiel to Merlin, from Daniel to Thomas the Rhymer." The whole host of heaven and hell may be engendered by abnormal condition of the blood-vessels, or their contents, which supply the sensory ganglia, and by consequent morbid excitation of the cerebral hemispheres. A sunstroke or an epileptic paroxysm may be the immediate cause of a throng of supernatural sublimities and horrors, which will mould the destiny not only of the seer himself during his brief span of life, but of half the world for more than eighteen centuries.

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* Life and Mind, p. 29.

Facts such as these, which cannot be seriously disputed by any practical alienist, should prevent men of Science from coquetting with animistic fallacies. Yet even so accurate an observer as Sir William Gull, who, in his recent article on Vivisection,† repudiates the exploded theory of "a mysterious vital force," and declares that "our corporeal life is but the operation of material atoms and material forces within the reach of experimental enquiry," cannot refrain from the inconsistent assertion, in a later part of his apology, when defending Medicine from the charge of Atheism, that "Science has to do with that which is external to us," and that "what lies beyond or beneath is relegated to other tests and to other evidence, of which it may be said that they afford more certainty than even Science can give us." Now since our "corporeal life" really includes our intellectual life, these "material forces" cannot be considered as "external" to us. If Science has to do with these, and with the mental phenomena which depend upon their operation, it embraces the whole sphere of consciousness, leaving nothing "beyond or beneath" to which any preter-scientific tests can possibly be applied.

The practical conclusions drawn by Dr. Lewins must command the assent of all who have acknowledged the validity of his premises. Since the belief in "immortality" (in the usual sense of the word) is inconsistent with materialistic views, it is plain that if Heaven is not for ever to remain an idle dream its delights must be realised on Earth. Perfect health is synonymous with perfect holiness,—

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* Life and Mind, p. 23.

† See note at the end of "Animal Automatism," in the April number of Journal of Science.

the two terms being etymologically one,—and consists in the harmonious development of every bodily organ. This is not to be misunderstood as a glorification of sensuality, or as an exaltation of muscle above mind; for the cerebral fount of intellect and morality will share in the common well-being, and will remain the lord of life, and the creator of that Paradise which is enjoyed by all the members.* Self-denial, or even Self-sacrifice, is not excluded from the list of virtues and blessedness; for in the exercise of such supreme moral qualities is the very essence of supreme personal and social happiness and well-being. Undue self-indulgence is forbidden by Science, and enlightened egotism itself as "fatal to that harmony of organic function on which true beatitude depends." This is surely no unworthy or incomplete ideal; and though our age seems at present far from this Kingdom of Heaven, it is the duty of each of us to labour earnestly for its realisation, and thus ensure its final epiphany. If this consummation can only be effected by a cataclysm which will overwhelm the present fabric of society, and destroy that boasted high-pressure civilisation and inhuman competition of which money-getting commerce and luxury are the chief end and aim, and misapplied Science the chief gauge of "progress,"†—that civilisation in which "the individual withers" and whose characteristic human products are narrowed down and specialised to that precise organisation which is best fitted for the making of a pin's head or the dissection of a moth's wing,—we must accept the inevitable "Decline and Fall" which History shows to have overtaken all our predecessors in the paths of Empire, —not without humiliation, not without self-reproach,—yet with trust in the better future of Humanity unchecked and boundless.

CONSTANCE ARDEN (C. N.).

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* See a tract by Prof. DU BOIS-REYMOND, of Berlin, "Ueber die Uebung," ably reviewed in the Journal of Science for March last.

† See, on this subject, Mr. Frederick Harrison's eloquent Lecture at the London Institution, in the April "Fortnightly Review," entitled "The Nineteenth Century."

II. THE ASSOCIATION FOR THE ADVANCEMENT OF MEDICINE BY RESEARCH: ITS TASK AND ITS OPPONENTS.*

THE medical profession and no small part of the scientific world have now for years endured the foulest, the most outrageous calumnies, and the grossest misrepresentations. The object of their assailants has been to render physiological research practically an impossibility. For in these days it must surely be admitted that any natural science which is deprived of the power of experimentation, and compelled to depend upon the mere observation of accidentally occurring phenomena, is in bondage, and cannot advance. These attempts—unfortunately too successful—have been conducted with a wonderful amount of energy and persistence, and with a remarkable degree of unscrupulousness. Money has been freely given, tracts have been scattered broadcast, advertisements have appeared in the political and literary press, at railway-stations, and on hoardings. Lectures have been delivered, and meetings have been held under pretence of discussion. In fact all the elaborate machinery of political agitation has been put, and kept in action. We may here ask how it is that the art of resisting and opposing "movements"—as they are called—has not been more carefully studied?

Medical men and non-medical biologists have meantime practically kept silence. They have, indeed, replied ably and triumphantly to the calumnies of their assailants; but these replies have appeared merely in professional and scientific journals which do not fall into the hands of the outside world. The leaders of the agitation, the "honorary" secretaries, &c., no doubt studied these replies, but very judiciously passed them over in silence. Hence the lay public, hearing the charges and meeting with no defence, fell into the not unnatural mistake of supposing that none had been offered, or was even possible. It was supposed that the accused were letting judgment go by default, and thus a very widespread and active prejudice—we will not call it opinion—was created against biological experimentation.

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* Reports of the Meeting at the College of Physicians.

Vivisection Scientifically and Ethically Considered in Prize Essays. By J. MACAULAY, M.D., Rev. BREWIN GRANT, B.A., and A. WALL, L.R.C.P. Edinburgh. London: Japp and Co.

The British Medical Association and the Vivisection Bill. By A. DE NOE WALKER, M.D. London: M. Walbrook.

There was another misfortune: the attacks were made by organised bodies, whilst the resistance was carried on by individuals. This was a twofold evil. Not the most illustrious name—be it even that of Richard Owen or Charles Darwin—carries as much weight as does a society. What is of even greater importance, no private individual had at his disposal the funds for issuing advertisements, handbills, and posters in reply to the slanders issued by the enemies of research. Physicians, professors, editors of learned journals, &c., have not time to range about canvassing for signatures to petitions. Hence the contest—if contest it can be called—was utterly unequal, and public ignorance was fully aroused and organised. Then came legislative action. The Vivisection Bill became law, and even this did not convince scientific men of the necessity of prompt, energetic, and united action. On the contrary, there was a widespread belief that with the passing of this measure our enemies would be satisfied. An esteemed medical contemporary even considered that the Act would not "in any material way" hinder the progress of research, and that it would "calm the needless apprehensions and put an end to the odious misrepresentations which have been recently rife concerning this subject, and which have been in ignorance adopted by persons of consideration who will probably in future take more pains to be correctly informed." Never did a forecast more signally fail. The agitation grew more furious, the misrepresentations waxed grosser; Bills were repeatedly brought in for completely abolishing vivisection under any circumstances whatever, and, if they have been hitherto rejected, what security have we for the future? All these onslaughts and menaces, however, did not rouse those concerned to action, and it was not till the outrageous prosecution of Prof. Ferrier that this most ill-advised apathy came to an end. Rumours have since then been circulated that something would shortly be done. What that something might be was concealed, perhaps judiciously, from the friendly portion of the press. At last it has been laid before friends and enemies alike, and the questions naturally arise whether what is to be done is the right and the sufficient thing? Let us, in the first place, express our pleasure that the protective movement was supported not merely by medical men and biologists, but by men eminent in other departments of Science, by clergymen, lawyers, and statesmen,—

men who are not personally engaged in physiological experimentation, but who recognise its importance and its necessity. But if we carefully examine the proceedings and sift the speeches delivered our satisfaction is not enhanced. The very title of the proposed society falls short of our expectations. It is organised for the "Advancement of *Medicine* by Research." Now there is much biological research needed, at present in abeyance in this country, which has no direct bearing upon medicine, and which very conceivably may never throw any light upon the healing art. Let us take as instances the investigations in which Dr. Blake has used the physiological action of metals as evidence bearing upon their atomic weights. Or we may mention all those researches in which animals are exposed to higher or lower temperatures, greater or less degrees of atmospheric pressure, different colours or intensities of light, varying hygroscopic conditions, &c. Such experiments certainly do not involve any "section" at all. But we are by no means certain that, given a foolish magistrate and able unscrupulous counsel, they might not be construed as infringements of the Act. Now researches of this class are of the highest importance as respects the origin of species, but their bearings upon medicine are very problematic. Will the proposed Association protect men engaged in such investigations? On a careful consideration of the speeches delivered, we see no clear evidence in the affirmative. Says Sir William Jenner, in his presidential speech, "Besides medicine it [the Association] would take in research in therapeutics, the effect on the human frame of some gases, foul air, and other things which rendered it susceptible to disease." In moving the formation of the proposed Association he is reported to have used these words :—"That with the view of bringing the legitimate influence of the medical profession to bear on the promotion of those exact researches in physiology, pathology, and therapeutics which are essential to sound progress in the healing art, an Association be formed, to be called the Association for the Advancement of Medicine by Research." Now on weighing these words, and on examining the utterances of the other eminent men who took part in the proceedings, we are reluctantly led to the conclusion that experimentation for purely biological purposes, independent of medical applications, is left out in the cold. This is the more to be regretted, since the anti-vivisectionist fanatics are quite astute enough to see the importance of drawing a distinction in their attacks between the medical profession and non-medical biologists. They are, in the first place, anxious to crush the latter. We are sorry to see the faculty falling into the trap, and thus, apparently at least, abandoning their allies.

We turn to another phase of the subject. Sir W. Jenner is reported to have said—"There was no desire on the part of those who had worked in the formation of that Association to evade the law; there was no desire on their part to ask for a repeal of the law, or even for any modification of it."

If these were the words really uttered—and uttered, as it seems, without any qualification on the part of the speaker himself or of others—we scarcely see that the Association has any well-marked *raison d'être*. This law which is to exist unattacked is the only tangible hindrance or danger against which physiologists require to be "protected." Let us for a moment consider the meaning of Sir W. Jenner's words. If the promoters of the Association do not desire a repeal, or even a modification, of the Vivisection Act, they admit it substantially as justifiable and necessary! By so doing, as seems to us, they condone the agitation which led to the passing of the Act and all its consequences, even to the indignities which medical Science has suffered in the person of Prof. Ferrier. We can easily conceive the rejoicings with which this speech and these admissions will be received in anti-vivisectionist circles. They will very naturally be accepted as evidence that the defenders of physiological experimentation either feel doubts as to the goodness of their own cause, or lack the energy and the courage needed for its defence. And as a necessary result the enemy will take heart and redouble their exertions to deprive physiologists of the last fragments and shadows of liberty which they still possess. Anti-vivisectionists have all along urged that the physiologists—unlike chemists, physicists, astronomers—"need watching." Now it will be said that they confess such necessity!

What is perhaps even more to be regretted, eminent men of Science and the leaders of the medical profession, if they accept the lines on which the Association is to be founded, accept at the same time all the illogicalities of which the Vivisection Act is so conspicuous an embodiment. According to this Act the higher and purer the motive the more culpable the deed. The man who skins a living frog and sprinkles it with salt for a wager escapes the censure of the law; so does the angler who impales a frog upon a hook as a bait for jack, and leaves it to writhe for an entire night; so does the youth who drenches a newt with petroleum and sets it on fire. But if anyone inflicts upon an animal one tithe of such torment for the sake of discovery he is liable to a penalty of £50, and, in addition, possibly to imprisonment. Yet, in spite of such absurdities and inconsistencies, Sir W. Jenner tells us that he and those who are acting with him do not even ask for a modification of the law! It might not be possible at the present moment, and while public opinion remains in its present morbid condition, to obtain a repeal of the law, or even for any substantial amendments. But public opinion, which has been industriously infected and corrupted by persons whom we may designate as social disease-germs, may under judicious treatment recover. Now to promote such recovery is, we are glad to find, one of the objects of the Association. Sir James Paget stated, very truly, " The Society to be formed would address itself to the really intelligent portion of the public, and enlighten them on the subject of medical science." This is very well; the public—even the respectable and intelligent portion of it, prelates and peers of the realm not excepted—are grossly ignorant on the subject of medical science. To enlighten them would be well, but what purpose would this enlightenment serve if it is not to pave the way to a repeal of the Act? Misrepresentations and sophisms have been the seed of the Act; public ignorance the soil in which it flourished. Can we seek to destroy those seeds and that soil with any other purpose than to ensure the withering of the evil crop?

We find Sir Risdon Bennet moving that " the Council shall take note of and seek to remove any hindrance which may appear to them to be operating adversely to the progress of medical knowledge." What is the " hindrance " save the Act in question?

There are some further peculiarities about the proposed Association which seem of doubtful expedience. There is no fixed subscription, " but members of the Association are invited to give such aid as they may desire to the general purposes of the Association, or towards special expenses incurred." This arrangement seems scarcely judicious, since, if the Council mean real business, funds must be regularly and abundantly forthcoming. To enlighten the public is a costly undertaking.

Again, if we do not misinterpret the reports of the proceedings, the membership of the Association is open, with the exception of some few official personages, to medical men only. Sir James Paget proposed " That registered medical men desirous of promoting the above objects shall, with the consent of the Council, be admitted as members of the Association on the nomination of an ordinary or corresponding member of the Council." We do not see it stated that other persons are eligible. Of course medical men, as the most numerous class directly concerned, must naturally take a predominating part in such a body. But we should have thought it judicious to accept support from whatever quarter it might be offered. The anti-vivisectionists have no restrictions on membership.

Having thus noted, we trust fairly, what the Association proposes to do, we may be permitted to glance briefly at what it overlooks and ignores. We should have expected that one of the very earliest steps taken by such a body would have been a solemn and dignified, but uncompromising denunciation of the Anti-Vivisection movement in all its manifestations,—in which denunciation all medical and scientific bodies, faculties, colleges, &c., would be urged to take part. We say "all scientific societies," and not merely such as occupy themselves specially with biology or natural history. Such is the solidarity of the sciences that a blow aimed at any will more or less be felt by all. Such a unanimous censure could not fail to carry great weight with the reflecting portion of the public.

Another step which might be useful, and to which we find no allusion in the programme of the new Association, is the formal refutation of the various writings, pamphlets, bills, and advertisements issued by the enemy. This is something supplementary to the mere general "enlightening the public."

A further useful move would be to obtain the names of all avowed Anti-Vivisectionists who are notoriously addicted to "sports" and other pursuits involving the infliction of pain and death upon animals, or who in their writings and speeches have shown themselves indifferent to human or animal suffering. A list like the following would be instructive :—

The Right Hon. A. B.	*Angler.*
The Earl of C. D.	*Courser.*
The Duke of E. F.	*Battue-sportsman and Hurlingham hero.*

Another point aimed at might be organised opposition to open and avowed anti-vivisectionists at all elections—parliamentary, municipal, &c. Let those gentlemen who are continually introducing into the House of Commons Bills for the further restriction of research know that, when next they appear before a constituency, the vote and influence of all medical and scientific men, irrespective of party, will be given against them. Similar steps ought to be taken as regards appointments to professorships, to medical offices, and as regards the membership of learned societies. The anti-vivisectionists have long since employed these or similar weapons against the friends of biological research. One of their stratagems, however, we do not recommend to be turned against them. We mean anonymous letters. Our enemies have freely made use of this cowardly means of annoying gentlemen supposed to be engaged in physiological research, or known as its defenders. Indeed the loud demands for the names of those to whom licenses for experimentation have been granted find here their explanation. The appeals for publicity mean "Give us the names of these men that we may try to instil prejudices into the minds of their patients!" Of such weapons Science cannot stoop to avail herself. But in other respects the war must be "to the utterance."

A further important point should be to obtain the opinion of the most eminent Counsel upon the Act. No one who is engaged in the study of animal life at all knows exactly when and where he is safe. This should be ascertained as clearly as possible. It is said that there is no Act of Parliament through which legal skill is not able to drive a coach and four.

Sir William Jenner, indeed, formally disclaimed any desire to "evade the Law." On this head opinions differ. Regarding the Law as a barrier to the progress of Science, we should pronounce any practicable evasion not merely justifiable, but laudable. The anti-vaccinationists and the "Peculiar People" are carrying their points by this very stratagem of evading, and even defying, the Law.

Looking seriously and calmly at the entire position, we cannot help regarding the formation of the Association for the Advancement of Medical Science as unsatisfactory. Fanatics, we submit, can only be routed if encountered with a resolution as uncompromising as their own.

For the thorough-going friends of Science there are, as it appears to us, two courses open: we may retire from the struggle in disgust, and hope that perhaps some unforeseen change may alter the present deplorable position; or, as there are several societies for attacking research, may there not be two, at least, for its defence? Suppose that a Biological Research Defence League is formed, open to all men, and pledged to adopt all conceivable agencies for the defeat of the Anti-Vivisectionist Agitation, and ultimately for the total and unconditional repeal of the obnoxious law!

(Gentlemen favourable to the establishment of such a League are invited to communicate with the Editor of this Journal.)

III. ON THE SENSE OF SMELL IN INSECTS.

By J. W. Slater.

IT is generally admitted that in insects the sense of smell reaches a power and a delicacy to which we find no comparison in other departments of the animal kingdom. Not only our unaided senses, but our scientific methods of research, are in comparison gross and ineffective. Our most skilful chemists tell us, for instance, that saccharose when duly refined is one and the same whether it be obtained from the sugar-cane or from the beet-root. But if we place the two side by side near a bee-hive, these little creatures soon show their perception of a difference by settling upon the cane-sugar, and leaving its northern bounty-defended rival untouched. Whilst, however, we so unanimously recognise the consummate olfactory power of insects, there has been a great lack of accord as to its seat. The antennæ, the palpi, the orifices of the tracheæ or respiratory apparatus, have all been declared to be the representative of the nose in Mammalia. Recently another view has been most ably advocated by Dr. Wolff, on the faith of certain delicate anatomical researches. This investigator has discovered a peculiarly differentiated tract in the soft membrane extending from the palate to the labrum, richly supplied with nerves, provided with certain parts which he regards as olfactory rods, and with a flask-shaped gland which appears to secrete a kind of mucus, serving to keep the above-mentioned membrane moist.

Whilst, however, there can be little doubt that the membrane in question subserves some especial function, and is probably an organ of sensation, there is, as it appears to me, no serious evidence derived from observation or experiment that the part in question is the seat of the sense of smell. On the other hand, not merely constructive but direct evidence is accumulating to show that this sense in insects has its seat in the antennæ. This evidence I will here endeavour as briefly as possible to unfold.

We will first give a short examination of the antennæ in the leading insect groups, noting particularly in what forms they are most highly developed. We find them, firstly, larger and more complicated—

In the males than in the females.
In adult insects than in larvæ.
In nocturnal species than in their nearest diurnal allies.
In groups possessing a relatively low degree of activity than in such as are remarkably swift on the wing.
In species which depend upon one kind of nutriment only as compared with such as are multivorous or omnivorous.
In species which are relatively large than in minute forms, which pass their whole career amidst a superabundance of nourishment.
In forms which lead an independent existence at least in the mature state, or in parasites which change their host rather than in true Epizoa which infest one and the same animal from birth to death.
In species where the development of the eyes is moderate rather than in those where it reaches a maximum.
In terrestrial species rather than in the aquatic.

A few instances will make these differences of development more intelligible.

The sexual distinction is exceedingly striking. In no case, as far as I am aware, are the antennæ of the male smaller and simpler than those of the female, whilst in a multitude of forms there is a well-marked excess in the opposite direction. This is very notably the case in the Lamellicorn beetles (e.g., *Melolontha fullo*), in certain nocturnal Lepidoptera, genera *Bombyx*, *Euthemonia*, *Arctia*, *Liparis*, *Orgyia*, *Odonestris*, *Saturnia*, &c. We meet with the same distinction in certain Diptera, where the antennæ of the male are beautiful plumes,* whilst those of the female are simply bristles.

Throughout the entire insect-world the antennæ of the larva, whether it resembles the mature insect in shape or not, are minute and simple. Indeed careless observers take an incredulous look if they hear mention of the antennæ of a caterpillar.

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* To the naked eye: much of this grace disappears if they are strongly magnified.

The distinction between diurnal and nocturnal species is often very plainly marked. If we take the most typically diurnal beetles, the tiger-beetles, the Harpalidæ, the Buprestidæ, the majority of the Elateridæ, we find the antennæ made up of linear portions like threads or bristles. Of the forms which have clavate, flabellate, or pectinate antennæ, a large part are nocturnal. Among Lepidoptera the case is very similar. The plumed antennæ, so common among the night-flying moths, are quite unknown among their diurnal kindred, the butterflies.

Of all insects those possessing the greatest locomotive power are probably the dragonflies. Here, accordingly, we find the antennæ very short and simple, never having more than eight joints, and being attenuated instead of enlarged at the tip. On the other hand, great complication of structure is met with in groups which are slow on foot, which take wing with difficulty, and do not steer well when flying, —all which attributes are well marked in the great family of Lamellicornes.

Of omnivorous insects we may take the common house-fly as a type. Scarcely any kind of organic matter comes amiss to its latitudinarian tastes, and here accordingly we find antennæ of three joints only. With such forms we may usefully contrast the carrion-beetles which do not ordinarily make use of any other kind of food, and whose antennæ all terminate in a jointed club, formed as if of a number of flat plates laid one over another, and, though joined together at their centres, yet detached round the circumference so as to expose a large surface to the air and the action of fumes and odours. Again, we may take the enormous family of Curculionidæ. Almost every species of this multitude is restricted for its food to a single plant or to a group of closely-allied forms, and here accordingly we see the antennæ always terminating in a club.

Of the simplicity of these organs in Epizoa the fleas and lice are a good instance. On the other hand, the Ichneumonidæ—which, though parasitic in their earlier stages, have, when mature, to lead an active life, and to search out an appropriate habitation for their young—have very long and highly-developed antennæ.

As an instance where the evolution of the eyes is complementary to that of the antennæ, we may take the same groups which we brought forward in speaking of locomotive power. In the dragonflies, and in the true flies, or Muscidæ, the eyes are as remarkable for their size and efficiency as are the antennæ for their minuteness and simplicity of structure.

To show the higher development of the antennæ in terrestrial than in aquatic groups, we need merely compare the Dytiscidæ with the Carabidæ, both similar in their diet and in their rapacious character.

Let us now ask ourselves what meaning underlies these structural differences in various forms? We cannot look upon the antennæ as mere ornamental appendages, like the crests, trains, and tufts met with in so many birds. Their ample supply of nerves characterises them at once as organs having some important function to fulfil. We glance first at their higher development in the mature insect than in the larva, and in the male as compared with the female of the same species. We know that of all the senses that of smell is most closely connected with sexual relations. Even in the human species it is comparatively in abeyance until the age of puberty. The indifference of young children to odours, pleasant or offensive, has often been noticed. It is by this sense in most animal species that the two sexes are attracted to each other; and as it is almost invariably the part of the male to take the initiative and seek up the female, he requires the more powerful and sensitive olfactory organs. If we take those genera of nocturnal Lepidoptera above mentioned, such as *Saturnia*, &c., where the antennæ of the male are so much more complicated than those of the female, we shall find two important points:—

a. The male is active in habit and possesses developed wings, whilst the female is in all cases sluggish and sedentary, often remaining at or near the spot where she has issued from the pupa. In many cases she is even practically wingless.

b. The male actually does follow the female by scent. This is proved by a host of observations made by insect-hunters in the practice of sembling. Male moths will come from a considerable distance straight to a virgin female enclosed in a box. To controvert the plea that such males are attracted by some sound supposed to be emitted by the female, but inaudible to human ears, it has been found that they will hover over and settle on any object upon which a virgin female has been sitting, or the empty cocoon from which she

> has crept. All these phenomena are rationally explicable if the antennæ are the organs of scent. They are utterly unintelligible if we suppose them to be organs of hearing or touch. On the other hand, it has not been shown that Dr. Wolff's organ has any exceptional development in the males of *Saturnia*, &c., either as compared with their respective females or with other species where the locomotive powers of the sexes are nearly equal, and where consequently the males require no exceptional faculties for seeking their mates.

We take the next case,—the relatively greater development of the antennæ in nocturnal groups, with which we may couple the inverse perfection of these organs as compared with the eyes. It will be admitted that if the antennæ are the organs of smell, this difference is precisely what might be expected. Species whose sight is exceptionally acute and powerful, and who in addition, like the dragonfly and the house-fly, are swift and enduring on the wing, have relatively little need of complicated scent organs. Conversely those which are slow in their walk and flight, such as the clumsy dung-beetles, and whose eyes are in comparison small or less advantageously situate, require an acute scent to compensate for the deficiency. It is very doubtful whether an enemy or a booty to be captured could approach a dragonfly from above, below, or behind without being detected. But, *e.g.*, the Dynastidæ may be approached from behind, from above, and to some extent from the sides, without coming within their range of vision. Here, therefore, especial delicacy of scent must be needed, or must at least be beneficial to such species as possess it. It may, then, be fairly submitted that the nicety of the sense which they need will be causally connected with the organs which in them are so signally developed.

We turn next to the distinction between the monophagous and the polyphagous groups and species. It can require no formal demonstration that the former must require more accurate means of seeking their nutriment than the latter. The blowfly, which loves carrion, but which in case of need does not object to the nectar of flowers, the juices of fruits, and the excreta of animals, is in little danger of starvation, and its sense of smell does not require to be finely discriminating. On the other hand, the sexton-beetle (*Necrophorus*), which feeds on small carrion, and nothing else; the *Geotrupes*, which preys on the excreta of the herbivorous animals, and nothing else; the rose-beetle, which consumes merely the nectar and the pollen of a few species of flowers—all require an organ of scent not merely acute, but nicely discriminating. Accordingly we find them endowed with highly complicated antennæ. Similar observations, which might be worked out to a greater extent than space here permits, all point in the same direction. We have therefore a case which falls under the method of "concomitant variations." We have evidence that a certain faculty varies in different insect groups. We see, further, that the development of a certain organ varies in a manner which may be pronounced parallel with the variation of the faculty. We are therefore, I submit, warranted in forming the provisional conclusion that the organ in question is the seat of the faculty in question.

I will now consider some of the objections urged against the olfactory character of the antennæ. It is maintained that a scent-organ must be placed in connection with the respiratory apparatus, so that a current of air laden with odoriferous particles may be drawn over its surfaces. This condition is essential, it appears to me, only when the organ in question is placed in the interior of the animal. An olfactory membrane placed in some deep cavity in the body, and not traversable by a stream of air, would be simply useless. But place the organ externally, where it freely encounters the atmospheric currents, and can if needful be waved backwards and forwards in the air, and this objection falls to the ground. Nor does the dryness of the antennæ seem a fatal objection. The entire body of insects is much drier than that of vertebrate animals or mollusks.

There are those who maintain that the antennæ are organs of touch. To this I reply that their excessive shortness in some species, and their delicate texture in others, renders them unsuitable for this function. In other species they are undoubtedly used as "feelers." But we must remember that in many Mammalia the nose serves this double function—*e.g.*, in the horse, the pig, and the elephant.

That they can be organs of hearing may be, I think, regarded as discredited by the considerations already brought forward, as well as by the fact that indisputable ears have been discovered in other parts of certain insects; those especially in which the faculty of hearing is most plainly present have their ears in the first abdominal ring just above the joint of the hind legs, and others in the tibiæ of the fore legs.

An argument in favour of the antennæ being the seat of scent must not be omitted: they can be readily applied to or turned towards objects to be examined, and this in a discriminating manner. Dr. Wolff's organ, on the contrary, does not admit of being specially applied to minute objects or thrust into crevices, as is done by, *e.g.*, the ichneumons in their search for latent larvæ or pupæ.

We now come to the conclusive test of direct experiment. For this purpose I have selected certain lamellicorn beetles. These insects, if suitably fed, can live for a considerable time in captivity, and, if not roughly handled or startled by sudden and abrupt movements, they show a certain degree of docility —I might even say of attachment. My first observations of this kind were made, many years ago, upon a very large male stag-beetle which lived in my vivarium for about a year.* If I took him out and set him upon a table he would travel about with the leaflets of his antennæ shut. If I held out a piece of pear or apple he would immediately advance his antennæ, open the leaflets, and march straight towards the desirable morsel. When it was laid down for him to eat he always passed his antennæ over it, just as a dog smells at any food given him. Having thus satisfied himself of the suitable quality of the food, he began to eat. With moistened brown sugar he behaved in a similar manner.

I have since made similar experiments with common dung-beetles (*Geotrupes*). If these insects were placed under a glass bell they remained quiet, or roamed listlessly about with their antennæ contracted, and the leaflets of the club closed. If a portion of excrement was then introduced the beetles became attentive, moved the antennæ about, opened the leaflets of the club, moved towards the dung, and examined it by applying the antennæ just as did the stag-beetle with the slices of fruit.

Similar experiments were made at different times with many specimens of the rose-beetle (*Cetonia aurata*). On offering these beautiful insects sugar or flowers—such as whitethorn or elder blossom—their behaviour was precisely the same as that of the stag- and the dung-beetles under similar circumstances.

Insects which do not possess club-formed or lamellate antennæ are less suitable for such experiments, as the very characteristic phenomenon—the expanding the leaflets or plates of the club—is necessarily wanting. But even species possessing simple antennæ behave in a similar manner.

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* After his regretted death he was transferred to my collection of Coleoptera, and measures $3\frac{5}{8}$ inches from the tip of the jaws to the posterior end of the elytra.

Thus I have repeatedly seen a *Carabus monilis* in my vivarium examine a small worm or caterpillar by moving his antennæ over it, without actually touching the prey. Specimens of *Vanessa urticæ* have made quite analogous movements on being regaled with moist sugar, and *V. atalanta* behaves in precisely the same way if presented with its favourite food—a piece of an over-ripe plum.

On the other hand, if any substance possessing a repulsive odour—*e.g.*, a fragment of carbonate of ammonia, or a lump of camphor, &c.—is placed in the track of an insect, I have observed the antennæ, if previously stretched forward, to be suddenly withdrawn and closed, just as we, on encountering an offensive odour, turn away our head and close or cover the nostrils.

These simple facts, which anyone who is so disposed may with little trouble witness for himself, seem to me to carry very great weight. We know that insects as a class possess the sense of smell in a very high degree of development. We know, further, that almost all animals endowed with this sense examine their food by smelling. Surely, then, we may conclude that those organs which insects apply to, or rather wave over, their food, and which are thrown into a state of evident excitement on the approach of any odoriferous article, must be the seat of the sense of smell. To suppose an animal examining its food by listening seems utterly absurd.

Other observers have gone much farther than I have done, and have reached substantially the same conclusion. Thus Le Père Montrousier, of New Caledonia ("Annual Record of Science and Industry," 1877), coated a weevil (*Octhorrhinus cruciatus*) completely over with wax, save the tips or clubs of the antennæ. On presenting to it oil of turpentine, which is an abomination to most insects, it showed strong marks of uneasiness, and endeavoured to escape. Another specimen of the same species had merely the tips of its antennæ coated with wax, and it remained perfectly indifferent to all strong-smelling substances. This pair of experiments must, according to the canons of inductive reasoning, be accepted as conclusive, and indeed form a good experimental instance of the application of the "method of difference." In the first case the fumes of the turpentine are absolutely cut off from every part of the body save the club of the antennæ; yet they are perceived by the insect, and recognised as a nuisance. In the second case the clubs alone are protected, and scents are no longer recognised. We are surely therefore warranted in the definite conclusion that the club of the antennæ is in insects the seat of the sense of smell. But the researches of Le Père Montrousier are confirmed by those of another observer. Dr. Gustav Hansen (" Zeitschrift für Wissenschaftliche Zoologie," xxxiv., p. 367) has studied the behaviour of insects towards strongly odoriferous bodies, both in the natural state and after the antennæ have been removed or coated with paraffin. In either of the latter conditions they ceased to recognise smells. Blowflies thus treated took no notice of tainted meat.

The conclusion may therefore be accepted as irresistible that the antennæ, and in particular their terminal portion, are the organs of smell. The internal organs, so minutely studied by Dr. Wolff, may indeed be organs of some sense, —possibly of one unknown to man,—but there is no evidence that they are in any way concerned with the perception and appreciation of odours. The assertion, on the other hand, of Dr. Vitus Graber (" Die Insekten," p. 305), that " no one has yet proved that the antennæ of insects evince any sensibility for odoriferous matters," will, in view of the direct evidence to the contrary given above, be permitted to find its own level.

IV. THE HIGHEST EDUCATION AND ITS DIFFICULTIES.*

HAVE we in reality reformed our Universities and their teachings so as to bring them into real harmony with the position and the wants of the age ? Professor Huxley in one of the works before us seems to reply in the affirmative. He tells us that the Recommendations of the Commission, of which he was an active member, have been well nigh anticipated by the spontaneous action of the Universities themselves. To what extent and from what point of view is this actually the case? We see in fact that splendid laboratories, fitted with every modern appliance for research, have been created. We find that chemistry, physics, biology, &c., are receiving some amount of recognition even though greeted with such contemptuous bye-names as the study of "stinks and bones." But in introducing new studies do we not still pursue them too much in the old manner? We teach say, Biology, but as something to be examined in, rather than as something to make discoveries in. The laboratories which have been so munificently founded, and in some cases even endowed, have not begun to pour forth even the first tricklings of a stream of researches such as flow from Berlin, Munich, Strassburg, even from Kasan and Perm. It has been well said that if the mediæval scholastics had possessed Newton's "Principia," or Darwin's "Origin of Species," they would have simply treated it as they did the writings of Aristoteles—made it the foundation of an infinity of verbal subtleties and quibbles. Just so we; give us what new subjects you please we simply misapply them.

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* University Reform. The Inaugural Address for 1881. Delivered at Canterbury College, New Zealand University. By Prof. A. W. Bickerton, Christchurch, (N.Z.) Tombs and Co.

Science and Culture. By T. H. Huxley, F.R.S. London: Macmillan and Co.

Oxford University Examination Papers. Second Public Examination. Honour School of Natural Science. Trinity Term, 1879. Michaelmas Term, 1879. Trinity Term, 1880. Michaelmas Term, 1880. Oxford: Clarendon Press.

Again the University reform spoken of is found wanting at the very outset. The man who enters an English University is still treated on the Procrustean principle. No matter what may be his especial powers, his tastes, his ultimate objects, there is imposed upon him one common course. So long as this uniformity is demanded from all alike, so long, we venture to say, will the English Universities be poor in original research. Very similar in their spirit are the remarks of Prof. Bickerton and the eminent authorities whom he quotes. All agree that our Universities are someting quite different from what we might reasonably expect, from what the honour and welfare of the nation demand, and it may be added, from what their founders and benefactors originally intended. Thus the Rev. Mark Pattison, Rector of Lincoln College, Oxford, declares "the colleges were in their origin endowments not for the elements of a general liberal education, but for the prolonged study of special and professional faculties of men of riper age."

Mr. Pattison again complains that the "colleges have become boarding schools in which the elements of the learned languages are taught to youths." The present condition of things he pronounces "nothing less than a state of national destitution and intellectual blight." Matthew Arnold, after declaring that it is the function of the University to develope into science the knowledge a boy brings with him from school, adds that "our English Universities do not perform the function of a University, as that function is above laid down." Professor Seeley, of Cambridge, writes: "The present insignificance of our Universities in the work of science explains itself very naturally by the system pursued in them." A Cambridge private tutor is quoted as saying, "If so-and-so did not think so much he might do very well." Thus we see that the "reform," so far, is only in appearance. Oxford and Cambridge men as well as those who have studied at German Universities, men of science, men of letters, and men of the world, alike tell us that our system is fundamentally bad, and that it is exercising an injurious effect upon the whole of secondary education.

As one of the causes of the disease, for it is nothing else, Prof. Bickerton justly, in our opinion, points out the undue cultivation of verbal memory which has so long ruled in the schools. "The successful schoolboy is often an unsuccessful man, because the glib word memory, that makes the thousand and one inflictions of the Greek verb an easy task, is not the chief requisite in the more important problems of after life." The author gives us from his own experience as science lecturer at Winchester College a very important observation which we do not recollect having met with before. "The junior classes exhibited distinctly more reasoning faculty than the elder ones. In many cases I have had the clearest evidence that mere memory work distinctly reduced the capacity for consecutive reasoning." Need we then wonder that so many boys who enter our public schools bright and intelligent come out as vapid dolts?

We must now turn for illustration of what has been said to the Oxford examination papers now before us, which, from many points of view, may prove instructive.

We have already rehearsed the well known truth that the exclusive attention formerly given at the old English universities to classics and mathematics no longer exists. The Natural Sciences are taught, and that by no means superficially. But are they taught fairly? There are two fundamentally distinct ways of ascertaining the proficiency and the capabilities of a student. We may either test to what extent he has succeeded in absorbing and assimilating the discoveries of others, or we may ask what are his powers of original research—of adding, in some department or other, to the sum total of exact, systematised human knowledge. These two methods do not invariably coincide in their results. The man who has the most original and suggestive mind, who is the best observer of phenomena, and the most happy in detecting their laws, is not always the one who can most easily retain in his memory and reproduce in the form of answers to questions the substance of approved text-books. There is a further distinction to be drawn. We may say to the student at his very matriculation in the words of Mephistopheles, "Waehlt euch eine Facultät," or we may enforce upon all comers, whatever their ultimated estination, one common course. In other words, we may seek to train either specialists or "good men all round." Thus we have, in fact, four different roads open, each in itself simple enough but difficult to combine together. It is scarcely legitimate to require from the student a remembrance, at once general and minute, of the whole scope of modern science, and at the same time to lay before him questions which, to be fairly answered, call for some amount of original research. It is injudicious and inequitable to oblige a man to distribute his time and attention among a great variety of subjects, and then expect him to show, in each or in any one, the knowledge of the specialist, who has made it the sole task of his life.

We turn, from personal predilection, to the questions set in Biology, and we cannot help noticing much that comes in collision with the views we have just set forth. We at once admit that the examinations in question are a reality and not a sham. No amount of mere verbal memory, even if aided by the utmost resources of "crammers" and "coaches," would here avail. Manipulative skill is tested; the student is called upon to identify specimens laid before him, to give a reason for embracing this or that theory, and on some points even to produce views of his own. This is so far highly satisfactory, though the question may be raised whether either the individual student or science itself is benefited by forcing into him at high pressure such an amount of learning in so brief a time. What is thus hurriedly bolted will hardly be assimilated. But after a careful inspection of the questions, their number, their scope, and their nature, we are forced to the conclusion that those for the Michaelmas Term, 1879, and the Trinity Term, 1880, are unreasonable under the conditions of the case. We will suppose that an Oxford man goes in for biology. His previous knowledge of the science will, in nineteen cases out of twenty, neither be extensive nor perhaps very accurate. Too often he will have something to unlearn. On entering college he will first have to pass Responsions and Classical

Moderations, which will occupy him to the end of his first year. After this he is required to pass an examination in physics and chemistry, in which a practical knowledge is demanded. Few can acquire this knowledge without working for two terms in the laboratory. The student, therefore, who intends offering himself for examination for honours in Biology has only two years and two terms remaining! Whether these requirements are judicious is not here the question. So long as they are upheld by the authorities of the University it is obviously the duty of examiners to draw up their papers accordingly. Surely it is unfair to expect young men, after so brief a study of so vast and complicated a subject, to deal with such questions as the following:—" Examine critically the statement that there is less difference between the structure of man and that of the anthropoid apes than there is between that of one of an anthropoid ape and the lowest existing simiæ." " Discuss the affinities of the Characeæ to the Red Sea-weeds." Give an account of the phenomena to which the term 'Reflex Action' was applied by the Physiologist who first used it. What explanations had been previously given of the same phenomena? In what respects has the application of the term been extended by writers of authority during the last twenty or thirty years? In what sense is it now most frequently used? Could any other, in your judgment, be conveniently substituted for it?"

" Comment on the following passages from Harvey's second letter to Riolan (passages quoted), in which he states his opinion as to the way in which the right auricle of the heart fills with blood. Give an historical account of the steps by which the knowledge we at present possess on this subject has been acquired." " What are the various types of structure observed in secreting-cells? Give examples and diagrams." " What are the microscopic characters of the contractile tissues of the higher plants?"

" Give some account of the earliest researches in anatomy carried on within the University of Oxford." " Trace from its earliest discovery the influence of the microscope, simple and compound, upon the progress of biological science."

" Write essays on any two of the following subjects * * * * The reciprocal adaptation of plants and insects. Putrefaction and other fermentative processes in relation to Bacteria. Segmentation or the repetition of similar parts in plants and animals. The definition of life."

We may surely say, that to do full justice to some of these questions and subjects, special original research is needed;

or to put it in the mildest form, careful undisturbed thought. Can a student, limited as to time and disturbed by the anxiety which most men feel when passing an examination, be fairly expected to deal with matters still open to doubt?

It is further to be noticed that in order to answer some of the questions the candidate must have been familiar with *recent* numbers of Prof. E. Ray Lankester's journal, the "Quarterly Journal of Microscopic Science." As instances may be quoted the following:—"Give an account of the fertilisation and early growth of the ovule of a flowering plant and compare the structures concerned with their homologues in Gymnosperms and Pteridophyta."

"Give a classification of the Medusæ and their related polyp-forms. Criticise the recent attempts to establish two groups of Medusæ by reference either to the characters of the nervous system, or, on the other hand, to those presented by the ovaries and spermaries."

"What is the mode of origin of the vertebrate red blood-corpuscule during embryonic and in adult life? What facts may be adduced from the histology of Invertebrata, which tend to throw light upon the origin and significance of hæmoglobine-coloured corpuscles?"

Could either teachers or students expect that questions would be set upon matter only just published at the time of the examination?

We thing it will be further admitted that great and sudden changes in the character of an examination, unless duly announced as impending for some considerable time beforehand, such as a year, are radically unfair. Yet such a change is most palpable in the examination papers before us. Those for Trinity Term, 1879, Dr. Pye-Smith (M.D., London) being then the examiner, are exceedingly fair—sufficiently difficult to exclude the incompetent, yet at the same time not going beyond what may be reasonably demanded from candidates whose time and opportunities for preparation are such as have been described. The practical knowledge of the students is duly tested in making microscopic preparations and dissections, as well as in naming numbered specimens of animals and plants, but no questions are asked demanding anything approaching to original research. W may here state parenthetically our opinion that when such research is required, the subjects ought to be either selected by the student himself, or otherwise should be given a couple of terms beforehand. To return to the examination papers. Those for Michaelmas Term, 1879, Prof. E. Ray Lankester and Dr. J. Burdon-Sanderson being now the examiners, show a completely different character, as we have already explained at some length. This character is maintained and even intensified in the papers for Trinity Term, 1880. It is right here to observe that Prof. Ray Lankester, being himself an Oxford man and having taught biology in that university, cannot be ignorant of what could under the circumstances be fairly expected from the students. It has been said that genius adulterates philosophy. Might it not, in a somewhat similar spirit, be urged that a man may be too learned, too able to examine average young men? It is important to note that the papers for Michaelmas Term, 1880, show a different character, much more like that of the papers set by Dr. Pye Smith. This return to more moderate demands upon candidates is perhaps due to the fact that certain teachers of biology in the university, without making any attack upon the examiners, memorialised the Board of Studies on the extreme difficulties besetting the study of the science under the existing conditions. It is difficult to formulate any absolute rule to prevent in future any such perturbations of the career of students as that we have just been describing. In a science which is growing so rapidly and undergoing such important changes as biology, it is not easy to select a set of text-books and decree that the answers to the questions propounded must be contained in these works and these only. Something must naturally be left to the discretion—not the indiscretion—of examiners. Between a list of questions which form no test of proficiency and another which might puzzle men of established reputation if required to be answered on the spur of the moment, lies a golden mean not too narrow nor hard to discover.

One final reflection may be allowed us. Suppose a student, who has passed such severe examinations as those for Michaelmas Term, 1879, and Trinity Term, 1880, were to become a candidate for an appointment in a museum. Would he be bound to undergo the "preliminary" scrutiny usual in "open competitive examinations?" Would his proficiency in orthography be tested by requiring him to write down a quantity of matter dictated or rather gabbled over by a "familiar" of the Civil Service Commission blessed with a questionable pronunciation and with an enunciation beneath all question?

V. A NEW FACTOR IN ORGANIC DEVELOPMENT.[*]

IT is now, we think, generally admitted, even by the most orthodox Darwinians, that natural selection does not suffice to explain the origin of all the features of the animal and vegetable kingdoms. It has been repeatedly shown in the *Journal of Science* as well as elsewhere, that the principle laid down by Darwin and Wallace, though it may account for the preservation of any favourable variation, throws no light at all on the origin of variation. To the question why did not the first protozoon launched upon the earth not simply reproduce its like *in secula seculorum* it can return no answer. A further difficulty is the explanation of the minute and exact purposiveness so often recognised in the animal organism. Here Natural Selection, even aided by Sexual Selection, is plainly inadequate. Here, consequently, the advocates of individual, or, so to speak, "mechanical" creation take their stand, and ask us to show how such an apparent adaptation of means to ends can have arisen? This problem has not newly arisen. Empedocles[†] dealt with it of old (one of the interesting proofs of what Greek philosophy might have been and done but for the great aberration mainly due to Socrates, Plato, and their following) and sought to explain purposiveness upon purely mechanical principles without the introduction of teleological considerations. With him as with Dr. Roux, "the purposive is not a something intended, but something which has come to pass; nothing teleological, but something natural; not that which corresponds to a pre-conceived plan, but that which had the properties necessary for existence, surviving." It may be scarcely necessary to add that this view is opposed not merely to the idea of individual creation but to that of Evolution[‡] upon certain given lines. We must further note that the principle of the struggle for existence, which is of course merely Natural Selection viewed from a slighty different stand-point, was first propounded by Heraclitus, with whom conflict, strife was the author of all things.

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[*] Der Kampf der Theile im Organismus Ein Beitrag zur Vervollstandigung der Mechanischen Zweckmässigkeits lehre. Von Dr. W. ROUX. Leipzig: Engelmann.

[†] Empedoclis Agrigentini fragmenta disposuit, &c. H. STEIN. Bonn, 1852. P. 4.

[‡] Why may we not, as some Americans have done, substitute for Evolution the plain English word "Unfolding?"

It must be admitted that Lamarck's principle, the action of use and disuse, furnishes a more direct explanation of the purposive than does Natural Selection. This principle has scarcely been sufficiently appreciated and followed out. Experimental evidence is wanting as to how far the modifications produced by use or disuse are hereditary. It seems to us, also, that many authors who admit that a muscle, an eye, &c., can be strengthened and improved by use, or, on the other hand, more or less completely atrophied by disuse, have overlooked the truth to which Prof. Du Bois-Reymond draws attention in a memorable discourse lately reviewed in the *Journal of Science* (1882, p. 165). The increase in bulk of a muscle as occasioned by regular exercise, and, conversely, its diminution if allowed to remain inactive, cannot fail to modify the nervous centres. We are thus brought to the principle which Dr. Roux discusses at length in the work before us. There is not merely a struggle for existence—a conflict between species and species, or between individuals of the same species. There is also a struggle within the organism itself, a conflict between molecules, between cells, between tissues, and between organs. By this conflict, intimately connected as it is with the Lamarckian principle of use and disuse, much of the adaptation, the purposiveness observed in the animal system becomes intelligible. Before considering more closely this internal conflict, which may, perhaps, be likened to the "competition" which in a community takes place between individuals, classes, interests, &c., we may return for a moment to the Lamarckian principle. This principle has been more fully recognised by Haeckel than by Darwin. The former considers that if *e.g.* the wings of domestic poultry have not been reduced to a mere rudimentary state, the cause must be sought in the insufficient number of generations which have elapsed since these birds were brought under human influence and in the circumstance that with them the struggle for existence is not very intense, so that the principle of "organic economy" does not come into play. Darwin, in his work on the "Variation of Animals and Plants under Domestication," lays a greater weight on the effects of use and disuse than he does in the "Origin of Species." Dr. Roux, after noting the somewhat perfunctory manner in which this question has hitherto been dealt with, proposes the following law of functional adaptation:—"With increased activity every organ increases merely in that dimension (or those dimensions) which subserve the augmented activity. Thus a muscle, which by increasing use may reach twofold its former thickness, does not gain appreciably in length. Thus functional hypertrophy does not occasion growth in all dimensions but in one or two only, and thus gives to a limb or to an entire animal new morphological characters. This transforming agency is facilitated, quantitatively supported, and complicated by its antithesis, the atrophy of inactivity, which is also subject to the same dimensional laws. But in order that these two principles may lead to transformations, permanent causes, which compel increased use or disuse, are necessary, and if the changes produced are to become hereditary, such causes must continue for generations. Dr. Roux also discusses the effects of a qualitative functional adaptation, without which the animal organism would remain on the stage which it has inherited. In this connection he quotes the utterance of Schiller in "Wallenstein"—"It is the spirit which creates the body."

But there are also considerations, still more completely overlooked, which may be included under the common name of functional adaptation, and which bear upon the effects of function in modifying the internal structure of the organs.

We find that Hermann Meyer* has detected what may be called a special architecture in the spongy tissue of bones, which always represents the lines of maximum pressure or strain to which the organ is exposed. Thus what may be called the bone-beams are so placed as to produce the greatest strength with the smallest expenditure of material. Other anatomists, J. Wolf, H. Wolfermann, Bardeleben, &c., have confirmed these observations and extended them to almost all the bones of man and of several other mammals.

A teleologist (Paleyan) or the like, admitting these facts, would claim this very structure as proof of special design and of individual creation. But it has been discovered by J. Wolff and confirmed by Kastor, Martini, and L. Rabe that such structural peculiarities are not something fixed, inherited, and inborn, but are capable of modification according to circumstances. Thus, if a bone is fractured and reunited in a crooked position, the lines of greatest firmness disappear from their normal places and take up new positions

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* Archiv für Anatomie und Physiologie, 1869.

in accordance with the modified direction of maximum strain or pressure. Hence the organism makes its own adaptations. Exceptional firmness is not designed to bear the strain, but the strain determines the firmness.

Professor Bardeleben and Professor H. Meyer have also communicated to Dr. Roux, as the result of researches not yet fully completed, that the fibres of the sheaths inclosing the muscles run likewise in the direction of the greatest strain. None of these arrangements can conceivably be due to Natural Selection. Passing over other illustrations of adaptation to be explained neither teleologically nor by selection, we come to the heredity of the effects of functional adaptation. However great may be the combined efficacy of embryonic variation and of selection, there is at least one occurrence in the evolution of the animal kingdom which is distinctly beyond their power. There is one point of which we can maintain that a step in advance must have been taken, not successively in single organs, but simultaneously in almost all organs, since advantageous variation in one or other part would not have been sufficient. This point is the substitution of an aërial for an aquatic life. The more closely we examine the conditions perhaps thousands in number, involved in the transit from the water to the land, the more we are convinced that such a change, however gradual, cannot be effected by Natural Selection. An animal attempting this transit would be at first distressed by the unwonted weight of its body and limbs, no longer supported by the water. In attempts at locomotion it must use its muscles in different co-ordinations. The bones, the cartilages, and sinews have new and heavier duties. The blood, now exposed for the first time to the full force of gravitation tends to leave the brain and spinal marrow, and to counteract this tendency and prevent an anæmia of the nerve-centres the entire circulatory mechanism must undergo a change. Oxidation will be deficient, now the lungs alone have to supply the entire demands of the system. The drying of the skin, the gills, and the lateral organs will cause abnormal sensations. The perception of the external world will be modified, and the senses, for the time being, will be thrown almost into inactivity. It may be, of course, admitted that the first visits of the animal to the dry land would be brief, and that an abode in shallow pools, *e.g.* during the recess of the tide, might in some respects form a transition-stage. Still the necessity of a simultaneous change in almost every organ of the body is apparent. Now functional adaptation on any change of the vital conditions is capable of effecting simultaneously suitable variations in all the organs concerned.

This simultaneous action, perhaps, in millions of parts must be considered as its characteristic in contradiction to the *modus operandi* of selection, which can develop only a very few properties at once. The question of heredity, upon which Dr. Roux throws a new light, must be for the present passed over in silence that we may proceed to the main subject—the conflict of parts in the organism. It must be remembered that even in the highest animals centralisation is not so complete as is popularly supposed. The foundation of the conflict of parts is their inequality; hence arises a struggle in consequence of growth and of the transformation of matter. It will be understood that each unity can come into collision only with unities of the same order. There can be no conflict between a cell and, *e.g.*, an organ.

Passing over the struggles of the molecules, the cells, and the tissues we may find this principle of conflict or competition most clearly shown in the organs. We find here heterogeneous parts contending for two requisites—room and nourishment. As a consequence it follows that only those combinations of organs can subsist in which parts chemically and physiologically non-equivalent can yet maintain a morphological equilibrium. For if one part were so successfull so powerful in its growth as quite to suppress the others, the whole must perish.

Though the inter-action of the organs has long been known and studied, it has not been viewed as a selective struggle for space. The mutual limitation of the intestines, especially the passive dependence of the shape of the liver, was noticed even by Vesalius. Rott has shown that in cases where the right kidney is wanting the normal depression corresponding to this organ is absent. The lungs depend in their size and form on the heart, the shape of the thoracic cavity, the diaphragm, &c. The cerebral hemispheres flatten the cerebellum. Muscles, *e.g.*, those of the calf, likewise flatten each other. This mutual conflict has led to the utmost utilisation of the available space. An increase of any organ is possible only at the expense of some other organ unless the latter has the power to resist its encroachments and compel it to grow merely in an outward direction. It must be noted that organs rarely if at all used may maintain themselves for a long time in places where they are exposed to no competition for space, as in the ear-muscles of man.

Dr. Roux is of opinion that this direct conflict of the organs for space will furnish a better explanation of many of the phenomena which Darwin groups together under the principle "Economy of Growth," than can be obtained by referring them to natural selection.

The organs engage in conflict also for nutriment. Goethe and Geoffroy St. Hilaire admitted this principle in their law of the "compensation of growth," which declares that when an excess of nutriment is required for building up any particular part, others are more scantily nourished, and are thus reduced in size. Darwin scarcely gives this law due recognition.

In summing up the results of this internal contest, the author makes use of a happy illustration. To deduce all advantageous properties of an organism from the results of direct selection in the struggle for existence with other individuals and with the outer world, is as great an error as would be committed by a sociologist or philosophical historian who should attempt to explain all the arrangements of a state in legislation, executive administration, science, art, commerce, and manufactures, from the effects of wars with neighbouring powers.

We have thus given a very meagre outline of a new factor in organic evolution. The idea of Dr. Roux seems to us to deserve most careful experimental investigation. Its true value can only be learnt from its actual application to some of the many unsolved problems with which the followers of Darwin and Wallace have so far contended with doubtful success. We do not suppose, nor does Dr. Roux for a moment insinuate, that the struggle within the organism, the conflict of parts, is the one and only consideration necessary to supplement natural selection. But we believe that it will be found of great service, and that it will prove especially efficient in explaining many of those minute delicate contrivances and cases of purposiveness upon which the advocates of individual creation still take their stand and upon which selection throws no clear light.

It may here be asked without for one moment seeking to undervalue the immense services which Darwin and Wallace have rendered to Science, whether evolutionists are not returning to a position more like that of Lamarck? Natural selection is no longer all in all. It requires the aid of the principle of use and disuse, of the influence of the external medium as analysed by Semper and, as we now see, of the internal conflict of Dr. Roux. Perhaps other agents which take part in the development of the organic world may yet be discovered, and may enable biologists to deal satisfactorily with the serious doubts which yet beset the question.

VI. ON TECHNICAL EDUCATION.

By Robert Galloway, M.R.I.A.

(Continued from page 224.)

IN the year 1764, Priestly, who was at the time a tutor in an academy in Warrington, published an Essay on a course of liberal education for civil and active life. "It seems," he remarks in this Essay, "to be a defect in our present system of public education, that a proper course of studies is not provided for gentlemen who are designed to fill the principal stations of *active life*, distinct from those which are adapted to the *learned professions*. We have hardly any medium between an education for the counting-house, consisting of writing, arithmetic, and merchants' accounts, and a method of institution in the abstract sciences; so that we have nothing liberal that is worth the attention of gentlemen whose views neither of these two opposite plans may suit.

"Formerly none but the clergy were thought to have occasion for learning. It was natural, therefore, that the whole plan of education, from the grammar-school to the finishing at the university, should be calculated for their use. If a few other persons, who were not designed for holy orders, offered themselves for education, it could not be expected that a course of studies should be provided for them only. And, indeed, as all those persons who superintended the business of education were of the *clerical order*, and had themselves been taught nothing but the rhetoric, logic, and school-divinity, or civil law, which comprised the whole compass of human learning for several centuries, it could not be expected that they should entertain larger or more liberal views of education; and still less that they should strike out a course of study for the use of men who were universally thought to have no need of study, and of whom few were so sensible of their own wants as to desire any such advantage.

"Besides, in those days, the great ends of human society seem to have been but little understood. . . . Few persons imagined what were the true sources of wealth, power, and happiness in a nation. Commerce was little understood, or even attended to. . . . *And thus, men's views being narrow, little previous furniture of mind was requisite to conduct them.*

"But the situation of things at present is vastly different from what it was two or three centuries ago. The objects of human attention are prodigiously multiplied; the connexions of states are extended. . . . In this critical posture of affairs more lights and superior industry are requisite; . . . and consequently *a different and better furniture of mind is requisite to be brought into the business of life.*

"This is certainly a call upon us to examine the state of *education* in this country, *and to consider how those years are employed which men pass* previous to their entering into the world; for upon this their future behaviour and success must, in a great measure, depend. *A transition which is not easy can never be made with advantage*, and therefore it is certainly our wisdom to contrive that the studies of youth should tend to fit them for the business of manhood, and that the objects of their attention, and turn of thinking in younger life, *should not be too remote from the destined employment of their riper years.* If this be not attended to, they must necessarily be mere novices upon entering the great world, be almost unavoidably embarrassed in their conduct, and, after all the time and expense bestowed upon their education, *be indebted to a series of blunders for the most useful knowledge they will ever acquire.*

"In what manner soever those gentlemen who are not of any learned profession, but who, in other capacities, have rendered the most important services to their country, came by that knowledge which made them capable of it, I appeal to themselves whether any considerable share of it was acquired till they had finished their studies at the university. So remote is the general course of study at places of the most liberal education among us *from the business of civil life.*"

One hundred and twenty years have very nearly passed away since Priestly first published his Essay; yet the complaint he made of the want of a system of school education suitable for boys intended for trade and commerce, or, as he phrased it, "for civil and active life, a course of studies that would best adapt them for the destined employments of riper years," is still unprovided for this class of youths in the United Kingdom. The children of the poorer classes have been provided by the State since Priestly's time, with schools, which exist in almost every village and in every district in large towns; with teachers who are trained for their work; with inspectors to see that the prescribed course of studies is fully and efficiently carried out; and the system of education is being continually improved. The higher classes are also provided with well-endowed public schools and universities; but "the middle class is dependent still, to a great extent, for its education on private desultory enterprise: this class, in this land of education, gets *nothing* out of the millions given annually for this purpose to every class except themselves."

The grammar-schools of the country are of course open to boys intended for trade and commerce, as well as to those who, after leaving school, are to proceed to one of the universities, yet the teaching staff and the course of studies provided in these schools are mainly intended for the education of the latter class, although in most country grammar-schools they form but a very small percentage of the entire number of the pupils. One of the London daily papers, in commenting on the result of the recent competition for the Cambridge Classical Tripos, gave as one of the reasons why pupils from the country grammar-schools frequently gain higher prizes at Cambridge and Oxford than the pupils from the great public schools, that it was owing to the large schools being, in comparison with small establishments, conspicuously *under-mastered;* at country grammar-schools the percentage of boys who are going to universities is comparatively low. Frequently at these smaller institutions there are only one or two pupils destined for Oxford or Cambridge, and the teachers devote themselves with extraordinary assiduity to this small number, in comparison to the rest of the pupils. The education of the many in such schools must be more or less sacrificed for the scholastic advancement of the few; but the evil does not terminate with the schools that yearly have one or more pupils preparing for the university, but extends to schools that never even have one pupil. Not many years have passed away when, in such schools, if a boy learned Latin he was not taught even English grammar, and all other subjects that would have tended to fit him for the business of life were equally neglected; and it is to be feared that in many country grammar-schools the state of education has not been much improved since that period. Attempts have been made to rectify some of the evils by combining in one Institution three separate schools, viz., an upper, a middle, and a lower school; but such a system will never equal the one adopted in Germany. In that country they have distinct and separate schools for different systems of education; they have, as we have, elementary and classical schools; but they have, what we have not, the *real* schools, and trade and mercantile schools. Other continental countries have established similar schools; but whilst France has developed most fully the apprenticeship schools, Germany has most fully developed schools for the education of those who are intended to be Directories of industries, and for those intended for a purely commercial career. We need not therefore be surprised that the present Chief Secretary for Ireland, the Right Hon. W. E. Forster, when speaking a few years ago on middle class education, stated that a young German who had to make his way in the world as a clerk had a much better chance than a young Englishman,—not because he was naturally quicker, but because, in consequence of the German system, he had received a much better education to fit him for business; or that Mr. Felkin, in his work "Technical Education in a Saxon Town," should thus express himself:—"Chemnitz is a large manufacturing town, like Nottingham, resembling it, too, in the fact that hosiery is one of its staple manufactures; and, moreover, as the town of Chemnitz has already taken away the glove trade from Nottingham, and is, in the opinion of many, slowly undermining the trade in cotton hosiery too, it cannot but be important to the people of Nottingham to know something of the educational advantages which have enabled the Saxons to do this. For, in the writer's opinion, neither in *physique* nor in energy and natural ability are these Saxons equal to Englishmen. On the contrary, the human raw material in Saxony is inferior to that of the Midland Counties, and yet the weaker race takes the bread out of the mouth of the stronger, and competes with it in the markets of the world. What enables it to do this?" The answer is, that it is mainly due to the Saxon's possessing superior educational advantages. Nor is it surprising that so many parents in this land of educational endowments and expenditure on education should send, or proceed with, their children to Germany,—a country "where there are no close and wealthy scholastic corporations; no rich independent church claiming a monopoly of education, and instinctively averse to change; and no blind adherence to old paths,"—to obtain for them an education suitable and adapted for their future pursuits in life. When staying in Bonn, some years ago, I saw, with feelings akin to pain, an English town springing up, inhabited, I was told, almost entirely by those who had come over for the purpose of having their children educated.

The first and essential requisite for an improved system of Technical education in England is the establishment of schools resembling the Real and Trade Schools of Germany. Without such schools the Technical Colleges which have been recently established in the country, by the munificence of private individuals, will not be of that service to the country they otherwise would be; for the students proceeding to them will too frequently have but a very imperfect acquaintance with one or more of the natural sciences: hence the Colleges will in part have to be turned into Elementary Science Schools, or the students will obtain but a very imperfect knowledge of such subjects.

ANALYSES OF BOOKS.

Evenings at Home in Spiritual Seance Welded together by a Species of Autobiography. By Miss HOUGHTON. Second Series. London: E. W. Allen.

THIS volume is a continuation of a work which we had the pleasure of noticing a little while ago. Some most remarkable phenomena are here recorded. Thus at a séance at which the author was present "a sudden and violent motion among the tubes startled us, and a quantity of snow and ice came down upon the table. We had the light at once and found that although such a large quantity had fallen, there was none upon the carpet or in any other part of the room. The lumps of ice were irregular in size, but the smallest must have weighed more than half a pound, and they where literally buried in snow. I noticed that the snow had the peculiarities of newly-fallen snow, and for a moment distinct feathery flakes could be seen, but the warmth of the room soon changed this appearance." The feathery character of the snow is the important point, for ice and snow, if packed in some non-conducting substance can be preserved for a considerable time in temperatures quite as high as that of a comfortable room.

The following is an almost equally uncomfortable manifestation. "We had a feeling as if something very light indeed were falling upon us . . . . at last we clearly made out that it was small downy feathers." On a light being made it appeared that the floor was covered over with down. It is added that on making a search on the floor above there was found the empty case of what had that morning been a feather bed!

On another occasion "when we were told to have a light we found the table was quite heaped up with flowers in delicious profusion. Mrs. Guppy, taking up one of the cowslips, called my attention to the fact that, on squeezing the end of the stalk, juice flowed instantly—a proof that they were but just plucked, for that even in ten minutes after flowers are gathered a kind of healing or drying process takes place where the stem has been broken off, so that it will not bleed."

If we may be permitted to make a suggestion we would ask Spiritualists to have brought by their unseen visitors, a live Goliathus, or Ornithoptera. No such creatures have ever been brought to Europe alive, and probably could not be unless a ship were specially fitted up as a floating conservatory. They could be at once identified by any naturalist, and would be, of course, incapable of being counterfeited by any juggler.

Miss Houghton received at her exhibition, a visit from an Evolutionist whose theory "bothered" her "not for one moment as to the thought of accepting it, but as to how the specious arguments were to be met." She "appealed for counsel" to some spiritual being and received the following reply: "Look at the rainbow. Where are the links in creation so close as the tints in its arching bow? Who may say where one shades off into another? Yet the blue remains blue, the red, red, and the yellow, yellow; the several creations are distinct, however closely they may be allied, or however harmoniously they may be blended." We doubt if a poorer argument in favour of mechanical creation was ever put forward.

Amongst other strange phenomena we find an account of Mrs. Guppy's being "transported by spirits from her home at Highbury to Mr. Williams's Séance in Lamb's Conduit Street."

The strangest matter in these pages, however, is an extract from the "South London Courier" of March 2nd, 1872. "A few months ago, a couple about to be married took a house in Berkeley Square, and upon concluding the transfer they were solemnly warned by the agent that a certain room in the house was haunted by a ghost. The mother of the bride said she would have no fear to sleep in the haunted room, as she was in the house superintending the arrival of the furniture. The lady was not alone in the house at the time of her venture; there were two or three servants also sleeping there. Nothing alarming was heard by them during the night, but the next morning when they went to call up their mistress they found her dead in bed with open eyes staring wildly at the ceiling. A medical man who was called in could give no satisfactory cause of death, which seemed to have taken place through some violent shock to the brain and nerves. But the newly married couple, much shocked as they were at the untimely death of their relative, were quite incredulous as to its having been caused by any supernatural agency; the husband at length prevailed upon his wife to consent to his making trial of the powers of the ghost. The lady stipulated that she should sleep in an adjoining passage, and that she should have the protection of a fierce bulldog and a pair of pistols, while two policemen were to be within call in another room. The gentleman retired to rest without any anxiety, taking with him a pair of revolvers. He also agreed to ring a bell twice should the ghost appear. About half past twelve the anxious wife heard the bell ring, first rather rapidly and then feebly. She flew into the haunted room and found her husband dead with his eyes fixedly gazing at the ceiling." The editor of the "South London Courier," Mr. J. E. Muddock, of 121, Fleet Street, in reply to inquiries wrote :—" While not being able to give you names and particulars at present respecting the Berkeley Square ghost, I vouch for the accuracy of the facts as narrated, and you are at liberty to use my name if you think proper." It is added that in each case a coroner's inquest was held, the verdict being that half blasphemous and wholly foolish survival "died by the visitation of God."

Miss Houghton gives it as her opinion that the victims did not die of fright, but had been literally murdered by malignant spirits.

We should feel much obliged to any one who could furnish us with either a confirmation or explanation, or a contradiction of this unpleasant story. There are several other "ghost stories" in the book, though none of so serious, or we may add so definite, a character. We have also some notice of the "elementaries,"—beings unconnected with man in any way, and described as of a lower grade.

The Slade trial is not overlooked. On this affair we have already pronounced our opinion, and need not again return to it further than to say that it has been out-Heroded by the attack upon Professor Ferrier. There is here (p. 257) a curious incident. A stationer named Lake, in Great Russell Street, had supplied Slade with slates. The prosecution, having heard of this "came to subpœna him to give evidence. When they found that the slate were just common ones with no contrivances of any kind, they *did not* summon him. All they had wanted was proofs of fraud."

A letter to Miss Houghton from a Rev. Mr. Barrett supplies further proof how Spiritualism is allying itself with one of the saddest fanaticisms of the day. He says "vivisection among other iniquities will be put down by terrible judgments from God!" The same writer gives a new remedy for illness, more powerful than mesmerism, to wit, solarised sugar. The finest powdered loaf sugar is exposed to the sun on plates for two successive days, at the same time each day, and is then preserved, covered with silk in the dark. Three teaspoonfuls daily are to be taken for five or six weeks.

We must pronounce this book, like its companion volume, worthy the careful study of the psychologist.

The Relation of Brain to Mind. A lecture delivered to the Dialectic Society of the University of Glasgow. By John Cleland, M.D., D.Sc., F.R.S., Professor of Anatomy. Glasgow: Maclehose and Sons.

We have here in brief compass an exceedingly able summary of the present results of modern science on one of the most important and difficult of all questions. The author belongs to a class of thinkers, unhappily, far from common; men who do not profess to be wise beyond what is demonstrated, and who will frankly confess ignorance rather than indulge in vague assumptions. He opens his lecture with a provisional definition of life. "Life is the capability of undergoing that series of actions by which an individual is not only maintained but determinately changed or developed by the attraction and disposal of particles drawn in from without and the extrusion of others." Whether any definition of such a primary fact as life will ever be fully satisfactory, we can scarcely venture to say; but Dr. Cleland's attempt is perhaps open to fewer objections than any which has been put before the world, especially if construed, as it may, to include reproduction.

Whilst speaking of albumenoid matter, without which no vital function is ever performed, the author makes some exceedingly happy remarks on the question of spontaneous generation, or as it is now more learnedly termed, "abiogenesis." "It is worth while to pause for a moment to note that whilet, here are enormous numbers of organic substances filling up the gradations of complexity between protoplasm and the simpler compounds of the organic world, not one of them occurs native save as a product of pre-existent protoplasm." This is an important and undeniable truth: between the products of the mineral kingdom —save where these have been derived from the decomposition of matters once living—we find no transition steps leading to, or even pointing in the direction of, the albumenoids. It may not be irrelevant to point out that the organic syntheses, of which modern chemistry is so proud, start not from *bona fide* dead matter but from the remains of what was once living. Dr. Cleland proceeds:—"Hence it follows that the numerous believers at the present day in the antiquated notion of the evolution of life from dead matter are placed in this dilemma—either they must admit that protoplasm, in the first instance, had its origin in other than the ordinary operations of inorganic nature, by a sudden spring from inorganic compounds totally at variance with the whole notion of an evolution, or they must be content to imagine an immense series of operations in days gone by altogether different from anything that takes place now, whereby simpler organic substances were formed first and protoplasm was formed out of them." An eminent man of science, whilst fully admitting the failure of all attempts made at obtaining life without antecedent life, still thinks that if it were given us to look back to the earlier ages of the world, we should see what now appears impossible actually coming to pass. We wonder which horn of the dilemma he would have elected?

Of the two great vital functions—nutrition and irritability— our author gives his attention to the latter. He fully accepts the "conclusion that with every mental action, whether intellectual, emotional, or volitional, a corresponding amount of oxidation of material takes place in the brain." This correspondence, he holds, is of the strictest character. But he does not agree with the assertion that the thought and the accompanying coincident cerebral change are one and the same thing. Such view he finds unthinkable, because "any physical change, whatever its character in detail, is mere movement in space, and that is an idea utterly incomparable with the idea of thought." He mentions another difficulty in the way of identifying thought with its physical conditions :—"Each thought, each memory, has a distinctness from all others, at the same time that it exists for the thinker alone ; while not only is physical change an objective antecedent of the subjective changes by which it is appreciated, but the particular physical change which takes place in any nerve-cell or living corpuscle of the brain when in action is always of one and the selfsame desciption, to wit, a combustion or oxidation and a corresponding electric disturbance."

Concerning these electric changes he adds :—"Living muscle and nerve separated in blocks from the body, so long as they are at rest, are in a state of remarkable electric tension of a description different from anything found in dead matter; but as soon as they are irritated this tension is diminished or ceases." This phenomenon is not understood, and calls for prolonged study,—study which, by the way, will scarcely be possible in England under its present hysterical *regime*.

We come to another problem : it is admitted that though the sensation bears a proportion to the stimulus, yet "the amount of subsequent mental action set up by a sensation has no quantitative relation to the sensation, and consequently none to the amount of energy liberated by the stimulus.

The author, accepting—as will be remembered—the mind as an immaterial entity, finds it insufficient to say that the mental and physical actions are simultaneous. The relation seems closer. "In the case of sensation you come to a stage—a transition-point—at which the purely physical changes are followed by changes both physical and mental, whilst in the origin of voluntary and emotional actions of the body there is a point of converse transition at which mental plus physical change is followed by purely physical change." The question naturally arises, How are these transitions to be harmonised with the principle of the conservation of energy ? Dr. Cleland asks "if energy has here a wider range than the material universe ?" Two answers only seem to him conceivable. Either the physical results of the action in the nerve-cells amount to the same sum as they would in case of the same action in cells unconnected with the mind, or to a smaller sum. The former alternative involves a breach of the principle of the conservation of energy, because, though brought about by physical energy, it is something over and above the normal results. If the physical results amount to a less sum, the difference is transformed from physical to psychical energy, and a bridge looms vaguely between, shall we say, matter and spirit? Dr. Cleland accepts the latter suggestion, and, though with admitted diffidence, formulates the startling conclusion that "a certain minute of energy in the production of sensation quits the physical for the psychical world, instantaneously to return again in the excitation effected by the sentient mind on the substance of the brain." But if thought and physical energy are mutually convertible, is not thought, after all, a form of physical energy? We can understand more or less clearly the mutual transformation of mechanical work, of heat, light, electricity, and magnetism; but if we see such energy transformed into thought, and thought re-transformed into physical energy, we are perplexed if the two are essentially distinct. To understand such a conversion is fully as difficult as to understand the identity of thought and cerebral change.

Whilst, however, we do not for the present feel free to accept Dr. Cleland's startling conclusion, we think that he has done well to raise a question which has hitherto been accidentally or purposely overlooked. The steps between an impression upon a sense-organ and the operations of mind and brain have not been closely tracked.

We strongly recommend this pamphlet to the serious study of all who feel an interest in questions concerning the human mind. No special biological knowledge is required for its understanding, and it is full of important and suggestive matter at which we have merely taken a passing glance.

Report on the Botanic Gardens, Trinidad, for 1880, *laid before the Legislative Council October* 1*st*, 1881. Port of Spain: Government Printing-Office.

We have here a most interesting and many-sided report bearing on the climate, the flora and fauna, the resources and production, present and prospective, of the island. Meteorological observations have been made of a regular and thoroughgoing character, so as to give a very fair picture of the climate. The annual and monthly rainfall, the atmospheric humidity, the cloudiness, the atmospheric pressure, and the temperature are very fully recorded. In the last point we notice the great regularity of an equatorial climate. For 1879 the mean temperature was 80·3° F. at 9.30 a.m., and 80·9 at 3 p.m. The yearly mean temperature for the nineteen years from 1862 to 1880, as calculated from the mean maxima and mean minima, ranged from 76·0 for February to 79·4 in May, and 79·0 F. both in September and October. There are thus two maximum points, and the yearly average range of temperature from the coldest to the hottest month does not exceed 3° F. The average atmospheric pressure for the same years is 29·878 inches in the morning and 29·791 in the afternoon.

The cloudiness is given on a scale where 0 denotes a perfectly clear sky and 10 total cloudiness. In this department we beg to suggest that more satisfactory results would be obtained with less trouble by means of Mr. Winstanley's radiograph (see *Journal of Science*, 1881, p. 218), which records automatically both the duration of actual sunshine and its intensity. It will, perhaps, surprise some readers to learn that the skies of Trinidad are very far from cloudless. During the above-mentioned nineteen years the lowest monthly cloudiness, for the months of February and November respectively, is 4·9 and 4·7, whilst in July and August it reaches 7·1. The atmospheric humidity is considerable, if 1·000 stands for perfect saturation of the air with aqueous vapour, the lowest degree of humidity, 0·674, is given as occurring in April and the highest, 0·841, in August. The average yearly rainfall for nineteen years, 66·39 inches, though about on a level with that of the rainiest parts of Britain, is not large for a region exposed to a tropical sun. The monthly rainfall has its maximum, 11·28 inches in August, and its minimum, 1·85 inches in April. The author remarks that one year, with the exceptional rainfall of 84 inches, he found in one part of the gardens the subsoil at the depth of 20 inches quite dust dry. The substratum in the Botanical Gardens is, probably, not directly moistened by the rain oftener than once in five or six years.

Insect pests are not wanting either in the gardens or in the island generally. The parasol-ants—probably the leaf-cutters—are said to have been unusually troublesome. We feel curious to know whether the nests have been attacked with the agencies proposed by our late friend, Thomas Belt—viz., carbolic acid and corrosive sublimate. Wasps and blight—probably aphides or scale insects—have also given annoyance.

We find here a remark on the conditions of tree-life, which is worthy of careful consideration. Says the author:—"It is a regrettable fact that the conditions of well-kept grounds are as a rule inimical to long-lived trees of majestic size and form. This is the case in temperate regions, but far more so here. The mischief arises from the removal of all fallen leaves and branches under the trees, which in a state of nature protect the roots from the sun and nourish the tree through them. It is well known that the majority of our forest trees, when their stems and base and surface roots are suddenly exposed to the sun, cease at once to thrive, and soon die outright. By the free admission of sun and air to the roots near the surface, the most harmful part of the dry season is intensified, and the beneficial influence of the wet season is greatly diminished." It is to be noted that the combination of beauty with neatness or "tidiness" is one of the most difficult tasks that man or even woman can attempt. It is also found that a love for the beautiful is not common nor highly developed where ultra-tidiness is rampant.

It must be remembered that a great part of the time and attention of the author, Mr. H. Pascoe, the Government Botanist, is taken up with experiments on the acclimatisation of valuable trees and plants from other tropical or sub-tropical countries, and in improving and ennobling species which are either aboriginal or have been introduced some time ago. We learn that the nutmeg tree is fully naturalised, and proves exceedingly productive. The yield per tree is over 20 lbs. of nutmegs weighed as ready for the market, and worth, on an average, 2s. 2d. per lb. Allowing on thirty female trees per acre, this signified a return of £60 yearly per acre.

Concerning the Liberian coffee (*Coffea liberica*) we find some interesting particulars. There is much less uncertainty with it as regards the "setting" of the fruit than occurs with *Coffea arabica*, and the tree prospers at a lower altitude. On the other hand, the proportion of the hull and husk and of the "parchment" is greater in the Liberian species. In flavour it appears inferior to the Arabian berry. The samples tested were distinctly wanting in the fine piquant aromatic flavour characteristic of Moka and the fine Trinidad Creole coffee. The comparative analysis of the two kinds, as given by Professor McCarthy, F.C.S., the Government Analyst, shows that whilst the Arabian berry contains 1·65 per cent. of caffeine the Liberian has only 0·77. The latter kind is, however, valued for mixing. It may be remarked that in France, and to some extent in America, different growths of coffee are judiciously blended. The only "blending" we understand in England is smothering the aroma of coffee under loads of chicory.

Attempts have been made to introduce into Trinidad the Litchee (*Nephelium Litchee*), and though the climate is too uniformly hot, the fruits have been delicious, resembling a high class muscat grape in consistence and flavour. As may be concluded from Professor McCarthy's analysis, these fruits, being rich in levulose and tartaric acid, seem likely to prove in China, Mauritius, Queensland, &c., a suitable material for wine. An efficient substitute for the grape is at present greatly to be desired.

The Chinese wax-tree (*Stillingia sebifera*) lives in Trinidad, but does not reach full vigour. In a climate less completely tropical it will, doubtless, be worthy of extensive cultivation, as its wax is of fine quality and is produced in abundance. We regret that lack of space does not allow us to notice the reports on the improvement of the cacao-crop by selection of strain, by improved culture, and by greater care in curing the beans, as also the experiments on the introduction of the African oil-palm, the true Durian, and many other valuable trees. We must be permitted to record our opinion that in Mr. Pascoe the colony possesses an indefatigable public servant, endowed with the all-important qualifications of a love for his duties, a thorough acquaintance with the conditions of plant-life, and a suggestive mind. The more it is to be regretted that he labours under marked disadvantages. The soil and site of the Botanical Gardens are not too suitable, and the grounds are not even securely fenced in. Stray cattle effect an entrance in the night, and may easily destroy the result of prolonged and patient labour. In these days, when the chemical science of Germany, France, &c., is waging a formal and bitter war against tropical agriculture, attempting to produce dyes, spices, medicines, &c., artificially, it is incumbent upon our colonial planters to defend themselves by the aid of chemistry and vegetable physiology, seeking to improve the quality and the yield of their crops. Liberal facilities afforded to able men will be found in the end an admirable investment.

Geology of the Counties of England and of North and South Wales. By W. Jerome Harrison, F.G.S. Science Demonstrator for the Birmingham School Board, late Curator, Leicester Town Museum. London: Kelly and Co.

We have here a most laborious, and we do not hesitate to say, a most useful compilation. There are, we believe, numbers of persons scattered up and down England who have a more or less complete acquaintance with geology such as may be gathered from books. But they naturally ask where some of the phenomena they have read about may be seen and personally examined without the time and trouble of a journey purposely undertaken to some celebrated locality? To such persons Mr. Harrison addresses himself; he tells them what there is to be observed in their own neighbourhoods, what to look for and where to look for it. By this means the student may make himself acquainted with the characteristic features of each formation in a relatively short time. Those again, who have already mastered the alphabet of the Science and wish to become observers, will find here useful guidance. Observation, we need scarcely say, requires a liberal outlay of time. Hence it is best that every qualified person should know what there is in his own immediate locality which needs closer examination. We quote here the following sentence which, though applying more especially to the county of Bucks, is not irrelevant elsewhere. "There remains an extensive field to be filled up by those who live on the spot. Every quarry, brick pit, railway cutting, or opening of whatever kind into the earth, should be diligently examined, carefully measured and drawn, and continually examined for fossils; in this way the broad outlines we now possess must be filled up, and if only one person in each parish could be induced to undertake such work, the gain to geological inquiry would be of real and great value." This is obvious, yet such close and constant examination can only be undertaken by local observers, and it is hence very important that such should have every facility given them. The work before us will, we think, assist no little.

The remarks on the characteristic scenery of the counties as resulting from their geological features are interesting and correct. The figure showing the cliffs of lower keuper conglomerate on Alderley Edge, Cheshire, will be at once recognised by all who knew that locality before it was invaded by building speculators. By the way, the author, speaking of the copper ores of Alderley Edge, makes no mention of the accompanying ores of cobalt, nickel, and vanadium.

The description of Kinderscout, the culminating point or rather ridge of Derbyshire, is strikingly correct. The view of the terraced lower escarpment of the chalk east of Chalgrave (Beds) is very characteristic. Concerning a similar set of terraces to be seen between Cheddington and Marston Gate Station on the Aylesbury Railway, we had once an argument with a local gentleman who persisted in declaring them to be artificial.

Another important feature of the work is the list of local natural history societies and museums, prefixed to the description of each county, along with a catalogue of important works or papers on the local geology. The list of societies and museums is unfortunately very limited, though not from any shortcoming of the author's. In addition, there is a list of the more important books treating generally of the geology of England and Wales. There is also under each county a notice of the maps and publications of the geological survey which may be usefully consulted.

Concerning local museums it may here be remarked, that much remains to be done before they will give the visitor a tolerably fair idea either of the stratigraphy, the palæontology, or, what might seem to appeal more directly to popular demands, the economic geology of the district. This is not as it should be, but we fear that in some influential minds the efficiency of a museum, a society, or a school of science, is less aimed at than its being brought under departmental control and centralisation.

Concerning the body of the book we can say but little, especially as the author does not profess to put forward either new facts or novel theories. In speaking of the Isle of Wight, however, he says:—"In these deposits of Wealden age we have evidence of a mighty river which flowed from west to east draining a continent which stretched far into the Atlantic; the strata formed in its estuary now extends from the Vale of Wardour, in Wiltshire, to the Boulonnais in France, a distance of 200 miles." Surely whatever evidence exists for the former existence of such a river ought to be taken into account in discussing the difficult question of the permanence or mutability of land and sea areas. The opinion is now widely entertained that former extensions of land have existed where the seas are now shallow, but that the beds of the great oceans are, and have been, permanent depressions in the earth's crust. As the question to us at least seems not fully decided, we think the considerations to which Mr. Harrison refers ought to be carefully weighed.

In ending this brief notice we must express our conviction that the "Geology of the English Counties" supplies and fills up an important gap in the literature of the science, and will be found a most valuable book of reference.

Vibratory Motion in Sound. By J. D. Everett, M.A., D.C.L., F.R.S., F.R.S.E., Professor of Natural Philosophy in the Queen's College, Belfast. London: Longmans and Co.

The branch of physics which treats of sound has latterly risen in importance, and may now fairly claim an equal rank with optics, thermology, and the sciences of electricity and magnetism. In the work before us we have a mathematical treatment of the subject of vibratory motion. In the successive chapters the author treats of simple harmonic vibration; of the composition of motions of translation; the composition of vibrations of the same period; of simple harmonic undulation; of the composition of two simple undulations of the same wavelengths, or of different periods; the propagation and reflection of sonorous undulations; on the stationary vibration of strings and columns of air; on the energy of vibrations; on simple and compound tones, and on musical intervals.

The treatise is specially intended for students already versed in the elements of dynamics.

An Attempt to Prove Newton's Law of Gravitation for a Resisting Medium. By the Rev. G. T. CARRUTHERS, M.A., Chaplain of Moradabad, India.

THE author remarks, "the theory of Sir Isaac Newton is drawn up like some pretty fairy tale. It is all very beautiful, but it is not a description of what goes on in every-day life. Who can believe the following to be the facts which they are said to be by all astronomers? 1. Heavy and light bodies are sent the same distance by the application of the same one force-producing mass to them. 2. A rotating sphere sucks bodies to its surface instead of hurling them away from it. 3. Common earth or stone can do work of itself without anyone making it do it. 4. Matter can draw other matter to itself through long distances without ropes, arms, or any intervening agent. 5. There are pleasant places in space where revolving bodies, once set in motion, never require any further looking after, as they go on turning for ever without the renewal of the applied force. 6. Gases, air, and vapour will not fill and permeate freely the room they are in. 7. Nature, without the aid of any known engine, in ages long past hurled the planets all at the same time along straight lines with enormous velocities, and with a speed calculated to the very foot per second, and having shown this care in putting them straight it then placed a body to pull them out of that course by a force acting under a law that no one can understand, except advanced mathematicians. It naturally died in the effort, for it never touched them again, and has attempted nothing like it since. 8. To these must be added another well-received theory, which, however, is not altogether connected with the Newtonian philosophy. Most of the matter in space has been made so hot that nothing that we know of can live in the greatest worlds; and even if the spheres were not hot, yet the force of gravity is so great that only flat creatures could live in them. Most of the spheres which are not hot, and in which the weights are not too hot for ordinary creatures to bear, are so cold that there cannot be a trace of life there, or of vegetation, and in moons living things would be thankful to get water and to breathe fresh air."

Here, surely, is matter for reflection.

CORRESPONDENCE.

⁂ The Editor does not hold himself responsible for statements of facts or opinions expressed in Correspondence, or in Articles bearing the signature of their respective authors.

THE SUN-SPOTS.

To the Editor of the Journal of Science.

Sir,—One cannot help being struck with the insufficiency of the theories of the sun-spots enumerated by M. Louis Figuier, in Chapter VIII. of his "Day after Death" (edition 1881). They only explain *accidental* spots; but if I understand rightly these spots are periodically exact, and located, *i.e.*, every eleven (?) years they pass through a full set of phases, which are again repeated. This cannot be the result of the "scoria" of the "German Physicist," or the "clouds" of M. Kirchhoff, nor probably the "ascending and descending vapours" of M. Faye, because it is utterly impossible for any such accidental causes as these to repeat themselves regularly. They are evidently regulated, then, by an immutable law. Comparatively speaking, it is reasonable to suppose that these must indicate a thin gaseous photosphere upon a solid globe. That the photosphere is gasified metals, &c., seems thoroughly established by the spectroscope. There would, then, seem to be some tidal influence at work on the sun's surface, and the spots would be so many unflooded spots. That there is some dark substratum Nasmyth's groups seem to show decisively enough, for there can hardly be a shadow where all is light. Suppose the photosphere only revolves round the fixed globe—an orb at war with itself?—I am, &c.,

D. Y. C.

Leeds.

SPIRITUALISM AND THE ANTI-VIVISECTION MANIA.

An exceedingly able contributor to "Light" (M. A. Oxon) takes exception to our remarks that the paper read by Mrs. A. Kingsford, M.D., at a meeting of the British National Association of Spiritualists, and an essay in "Light" by Mr. Crosland, indicate a hostile feeling on the part of Spiritualists toward Biological Science. We fully admit the contention that a Society or Association is not bound by the acts of a single member. But there is nevertheless a distinction to be drawn which so acute a thinker as "M. A. Oxon" cannot fail to recognise. It is this:—Every Society has a certain range of subjects to which its attention as a Society is supposed to be limited. These subjects are not necessarily pointed out in the Laws or the Bye-laws of the Society, but the limitation is accepted both by members and by the outside public. So long as a member keeps within this pale the Society is not committed to his opinions, be they right or wrong; but if a member is allowed to travel beyond the boundary, and to discuss subjects which lie outside, it seems to us that the Society becomes responsible.

To take an instance: let us suppose that a violent attack upon Spiritualism were introduced at a meeting of the Institution of Civil Engineers; we feel certain that the speaker would be stopped, however hostile to Spiritualism the majority of those present might happen to be in their individual capacity. Moreover, if the reading of such a paper were permitted, we think that Spiritualists would have every right to complain that the platform of a supposed and ostensibly neutral body had been used in a hostile manner.

The case of Journals is substantially the same. We remember feeling exceedingly disgusted when the "Inventor's Record"—a purely technological paper—took a position hostile to Spiritualism on occasion of the "exposure" of a medium by a certain Herr Carl von Buch. We considered that our contemporary was acting altogether *ultra vires*, quite irrespective of the validity of his arguments.

It seems to us, in fine, that the British National Association, by allowing Dr. Anna Kingsford to read her paper, has acted like a State which in time of war allows its territory to be used by one of the belligerents as a "basis of operations."

Candidly speaking, we regret not having called attention to Mr. Podmore's reply to Mr. Crosland.

The Editor of the Journal of Science.

THE "ERRORS" OF THE OLD ANATOMISTS.

To the Editor of the Journal of Science.

SIR,—Whenever the result of modern investigation varies from that of the older anatomists, the latter are peremptorily condemned. Is this a perfectly safe procedure? Is it not open to doubt whether they might not have been right *then?* Some of the blunders are indeed extraordinary.

May not the different results yielded now, perhaps, arise from a further physiological evolution since then? Nor is this unplausible when we consider that it is more than 2000 years since Aristotle wrote. Hippocrates lived earlier still, and it is over 1600 years since Galen flourished.

E. g., if I am not mistaken, we are told that Galen describes the upper jaw as being divided into two bones, which is not the case now; hence Galen is condemned as wrong, or as only drawing his results from animal dissections. Would he have made such a mistake?

Therefore, looking at the matter in this light, one is surprised to see Prof. Huxley ("Science and Culture"), in defending one of Aristotle's "errors," say of certain others "Not so much to be called errors as *stupidities*. What is to be made of the statement that the sutures of women's skulls are different from those of men; that men, and sundry male animals, have more teeth than their females;* that the back of the skull is empty; and so on?" *Were* the heart, lungs, &c., as he describes; were also these things "stupidities" then? (as they undoubtedly would be if things were then as now).

It is argued that the ancients, and therefore our quoted philosophers, never dared to dissect a human body, yet it is impossible to get rid of the impression that they did (*see* Hallam, in his "Literature of Europe," Chap. II., § 37).

If Prof. Huxley is rightly reported, and is correct in his translation and authority, that human beings were dissected seems placed beyond doubt by the following extract from page 188 of "Science and Culture":—"The lung is divided into two parts; but in those animals which bring forth their young alive the separation is not equally well marked, *least of all in man.*"—(Aristotle, Book I., 16).

We know that, in spite of the immense prejudice against this "sacrilege," Mundinus, the father of modern anatomy in Italy, in the fifteenth century, managed to dissect "on the sly," when to be found out might have been death; and so with Zerbi, of Verona; Berenger, of Carpi; and the great Vesalius, later on, whose students used to go and dig up their ghastly objects from their graves, and steal at midnight, tumbling back with their loathsome burdens.—I am, &c.,

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* It is a very familiar fact that some people amongst us only develop two incisors in each jaw, instead of the usual number, though this is not confined to females, I think, nowadays.

D. Y. C.

Leeds.

FISHER'S "PHYSICS OF THE EARTH'S CRUST."

("Journal of Science," No. XCIX., March, 1882, p. 168.)

To the Editor of The Journal of Science.

SIR,—The Reviewer states that "an attempt has been made by an eminent authority to fix a maximum limit for the time which has elapsed from the solidification of the Earth's surface down to the present day," and adds that "the results reached . . . vary from 33 to 300 million years." The period of 33 million years is one obtained, not by the "eminent authority," but on his hypothesis, with the assumption of a lower temperature of solidification, by Mr Fisher ("Physics of the Earth's Crust," note, p. 71). It appears from the Review as if Mr. Fisher attributes to Sir W. Thomson the conclusion that the rate of increase of the temperature within the Earth becomes *nil* at about 5000 feet below the surface. This is not Sir W. Thomson's conclusion, but Prof. Mohr's, and was deduced by him from an erroneous method of interpreting the Sperenberg observations ("Physics of the Earth's Crust," p. 12). Sir W. Thomson states, on the contrary, that the increase will not diminish sensibly for 100,000 feet or so. ("Secular Cooling of the Earth," Nat. Phil., p. 720).

Thirdly, the Reviewer has attributed to Prof. Tait a passage quoted by Mr. Fisher from a tract by the Bishop of Carlisle, in which the concluding clause alone is taken by the Bishop from Prof. Tait ("Physics of the Earth's Crust," note, p. 74).

NOTES.

Vivisection.—Last spring the naturalist, Carl Vogt, met at the Algerian Congress an English physiologist, Dr. Martin Lister, who informed him that because of the English law against vivisection he was obliged to leave that country whenever he wished to make experiments on animals. "Can you believe," said he, "that I was forced to leave my practice there, and start again professionally in France, so as to be able to make some experiments on horses necessary for the completion of a work already commenced? I applied to the English authorities, and they informed me that they would willingly close their eyes to the fact that I was practising vivisection, but if it pleased some clergyman or old woman to prosecute me, no one could prevent me from being heavily fined, or even imprisoned. I have therefore come to Toulouse, where I have kindly been supplied by the authorities with all necessaries." Carl Vogt accompanied this statement with the following remarks:—"In the case of a human being the doctor has the whole control, he practises the most dangerous operations, and administers the most violent medicines on his own responsibility. Why is it then more dangerous for animals than human beings? Why do we find it abominable to try the effects of a new remedy on an animal before using it for man?" M. Carl Vogt declares that there exists in Germany a movement analogous to that which led to the law against vivisection in England. M. Virchow fears that it may be successful.—*Medical Press and Circular.*

The American Association for the Advancement of Science will hold its thirty-first meeting in Montreal, Canada, during the week commencing on August 23rd, under the presidency of Prof. Dawson, LL.D., F.R.S., Principal of the McGill University. Twenty-five years have elapsed since its former meeting in Montreal, and in this period the Association has increased greatly in numbers and importance. The Committee have made arrangements with the various Steam-Ship Companies to encourage scientific men from Europe to attend the meetings of the Association.

According to the "Gazzetta di Napoli" the deaths from delirium tremens and chronic alcoholism are in Italy 1·65 per thousand; in England, 2·04; Norway, 2·36; Scotland, 3·29; Belgium and Switzerland, each 3·83; Sweden, 6·25; and New York, 12·08.

Signor Giunti (" Gazz. Chim.") has found an average of 0·8 per cent of copper in the excrements of bats.

Dr. O. Bütschli ("Zoologischer Anzeiger)" shows the non-existence of individual death in the Protozoa. These mono-cellular animals cease to exist as such in the act of propagation, and the individuality of each is split up into the two new individualities of its offspring. No organic matter is thrown out of vital activity, as occurs on the death of the Metazoa. A protozoon may perish by accident, but it does not necessarily carry, like the higher animals, the germs of death in itself.

" Picro-sulphuric acid," for the preservation of specimens, is made by taking 100 parts of a saturated solution of picric acid in cold water, and adding 2 parts of pure sulphuric acid. For insects this mixture is used undiluted, but for mollusks, &c., it is let down with three times its measure of water.—*Zoologist.*

Mr. Stradling, in an able paper on Snakes in the same journal, mentions the occurrence in the New Forest of *Coronella lævis*, a true snake not generally known to inhabit Britain.

At the April meeting of the Entomological Society it was stated that three queen wasps (*Vespa germanica*) were taken on January 15th of the present year—the earliest appearance on record.

At the same meeting Mr. Billups exhibited a new method of putting up small insects. They are gummed upon the circles of thin glass used for covering microscopic objects. These are again fixed at the back to a slip of card supported by a pin. In this manner the under side of the specimen is open to examination.

" Light " records the detection and exposure of three professed mediums in the United States.

Prof. Borggreve (" Forst. Blätter ") denies that woods produce an increased quantity of rainfall.

M. Van Hasselt laid before the Academy of Sciences of Amsterdam the skin of a cobra, from Sumatra, of the unusual length of 3·9 metres (12½ feet). It agreed with a second specimen in the author's collection which he has already described as *Naja ingens.*

M. Poulet (" Comptes Rendus ") seeks to show that the acidity of the gastric juice in man is hippuric acid.

MM. E. Perrier and J. Poirier take exception to the views of Prof. Jourdain on the reproductive organs of the sea-stars as given in the " Comptes Rendus." They hold that the circular dorsal canal and the hydrophoric pouch have no connection with the excretory apparatus of the genital glands.

According to the "Archiv. d. Pharm." the different kinds of aconitine nitrate met with in commerce vary greatly in poisonous power. That of Petit is 8 times stronger than Merck's, and 170 times stronger than Friedländer's.

Dr. J. D. Thomas, on behalf of the Colonial Governments of Adelaide and Victoria, is engaged with researches to prove that the prevalence of hydatid disease in man and in the lower animals is proportionate to the number of dogs kept in a community.

According to Prof. Jules Gaudard (Institution of Civil Engineers) the force of waves, beating against exposed structures, may reach a pressure of 6000 lbs. per square foot, The maximum wind-pressure registered in England has been 71 lbs. per square foot.

Mr. E. Wadsworth considers the copper-bearing rocks of Lake Superior as of Potsdam age.

M. P. Bert (" Comptes Rendus ") shows that the blood of animals originally belonging to, or acclimatised in, high mountain regions, has a much greater capacity of absorbing oxygen than the blood of the same or of analogous species living at lower altitudes.

The " Popular Science Review " sharply criticises Prof. Goldwin Smith's attack upon Mr. Herbert Spencer's ethical system, and makes some good points. But no one seriously inquires whether Evolutionism fairly admits of the conclusions deduced from it by some of our " advanced " thinkers.

According to MM. Heckel and Schlagdenhauffen (" Comptes Rendus ") the kola-nut contains more caffeine than coffee, along with theobromine and grape-sugar. It is rich in starch, but poor in fatty matters.

With reference to the supposed protection against sewer gases offered by water-traps, the " Medical Press and Circular " reminds scientific men that the water absorbs the sewer gases in the soil-pipe, and then gives them off into the house.

Mr. E. Ray Lankester, F.R.S., &c., has been definitely appointed to the chair of Natural History in the University of Edinburgh, and has since given in his resignation.

We learn that at a complimentary dinner given at Halifax to Mr. T. Dolan, F.R.C.S., of that town, it was proposed to found a local Medico-Chirurgical Society and a medical library in connection with the Infirmary.

A mixture or alleged compound of glycerine and boracic acid is being put forward as an agent for the preservation of articles of food. Considering that boron is not an element naturally occurring in animals or vegetables, we think that its use will require to be cautiously watched.

Dr. Gordon (" Scottish Naturalist") gives an account of a fishing frog (*Lophius piscatorius*) being found dead with a recent specimen of the great black-backed gull (*Larus marinus*) in its stomach. He suspects that the frog died from having swallowed the bird.

The Senate of the University of Edinburgh has decided to confer the honorary degree of LL.D. upon Dr. R. Angus Smith, F.R.S., and Dr. John Simon, F.R.S.

In the " Medical Press and Circular " Dr. Mason, of Hull, is reported as declaring that zymotic diseases had increased since the introduction of the present educational system. This is decidedly probable.

M. J. Chappuis (" Comptes Rendus ") has examined the absorption spectrum of pernitric acid. It is characterised by fine black lines, very distinct, and totally unlike the broad, grey, somewhat indefinite bands of ozone by which pernitric acid is always more or less accompanied.

M. P. Bert has been elected a member of the Academy of Sciences (Section of Medicine and Surgery) *vice* M. Bouilland, deceased. M. Brown-Sequard obtained merely one vote !

According to M. J. Tayon (" Comptes Rendus ") African asses are able to resist splenic fever. Repeated inoculations produced merely a local tumour, which remained for about a week, whilst the general health of the animals was not affected.

It is interesting to find that a " lunatic," claiming, like Guiteau, a divine mission, has shot Dr. J. J. Gray, who was one of the witnesses called to rebut the plea of insanity raised on behalf of Guiteau.

Dr. Sozinsky (" Medical and Surgical Reporter ") gives as the normal stature of a male child, at the end of the first year, 30 inches in height, and 25 lbs. in weight.

The Fungi which appear in decaying articles of food, though usually harmless, are occasionally, and under unknown conditions, accompanied by other low organisms of a very deleterious character.

M. G. de Saporta (" Comptes Rendus ") has discovered, in the Middle Permian beds of Jelovick (Russia), impressions of a curious species of Ginkgo, a form represented in our days by a single species, and not traced hitherto farther back than the Rhætian.

Dr. Koen has proved, in a memoir read before the Physiological Society of Berlin, that tuberculosis is due to a special microbion—a *Bacillus* not unlike that of *Lepra*.

The "Medical and Surgical Reporter" (Philadelphia) contends, in an able editorial, that much mischief is done by sending children to school too early, and that the portion of life prior to puberty should be mainly devoted to physical development.

It appears that the Government intends to appoint two official toxicologists to conduct the analysis of the bodies of persons whose death seems to necessitate a special investigation. The nomination of these analysts will be entrusted to the Presidents of the Colleges of Physicians and Surgeons.

The "American Naturalist" says:—"On this point (the origin of mimetic coloration) the Darwinian is on the same footing as the old time Creationist. The latter says God made the variations, and the Darwinian says that they came by chance. Between these positions Science can perceive nothing to choose.

According to the same journal wild geese have become a pest in the San Joaquin Valley, in California, and are committing great depredations.

Dr. J. A. Osborne proves the extensive occurrence of parthenogenesis in *Gastrophysa raphani*.

By the will of the late M. Jules Putzeys his valuable collection of Coleoptera has become the property of the Entomological Society of Belgium.—*American Naturalist*.

Dr. C. A. Gordon ("Medical Press and Circular"), in an interesting paper on "Climate in Relation to Organic Nature." whilst admitting the injury occasioned to climate by the removal of forests, stated that neither Conifers nor the Eucalyptus absolutely abolish malarial disease and cholera.

Dr. Cohnstein, of Heidelberg, is of opinion that in women, as in other female mammals, impregnation takes place principally at some particular season of the year.

Dr. A. S. Packard, jun. ("American Naturalist"), criticises Prof. E. Ray Lankester's memoir "Limulus an Arachnid" ("Quarterly Journal Microsc. Science"), and contends that the species in question is essentially Crustacean.

We regret to learn that M. Eugene Boutney, a zealous investigator of the ptomaines, has recently died of carbuncle due to absorption of some of the very poison in question.

One Mr. Bergh has recently come forward as a furious Anti-Vaccinationist, in the February number of the "North American Review."

A correspondent of "Light" suggests that it might be well to discourage *post-mortem* examination till the body has been cold at least three or four days: for if the Spirit should be capable of feeling the terrors of the surgical operation, it must be a trial of unequalled horror. Surely such a delay must in many cases be in danger of frustrating the very objects for which *post-mortem* examinations are undertaken.

The Report of the Mining Surveyors and Registrars of Victoria gives the proportions of gold from quartz rock obtained at different depths. The richness of the mineral stands in no perceptible relation to the depth at which it lies. The richest sample (10 ozs. 9 dwts. 12 grs.) was got at the depth of 840 feet. One of the next richest (3 ozs. 10 dwts. 12 grs.) at 130 feet; and the poorest of all (16 grs.) at 400 feet.

We regret to learn the death of an occasional contributor to our pages, Mr. J. Hepburn Davidson.

The German Congress of Naturalists and Physicians will meet this year on September 17th.

M. E. Brandt has laid before the Academy of Sciences an account of researches on the nervous system of certain Dipterous larvæ of the families Leptidæ, Bibionidæ, Xylophagidæ, Therevidæ, and Dolochopididæ. The larvæ of the Leptidæ have thirteen ganglia, *i.e.*, two cephalic, three thoracic, and eight abdominal, all connected by double nerves as in the adult insects. In all other Diptera the ganglia are united by single connections. The larvæ of the Bibionidæ, Xylophagidæ, and Therevidæ, as well as the Asilidæ, have the same respective numbers of ganglia with simple connections. The adults have merely two thoracic ganglia, the anterior one being formed from the two first in the larva, whilst the posterior ganglion is formed from the third of those of the larva. In the larvæ of the Dolichopididæ there are still the same number of ganglia, which in the adult are reduced to four—two cephalic and two thoracic. The larvæ of the Fungicolæ have sometimes thirteen, sometimes twelve ganglia, the two posterior in the abdomen merging into one, as in Rhyphus. The larvæ of the Tabanidæ have only seven distinct ganglia. M. J. Künckel d'Herculais maintains that they have merely two. Is this a difference of species or of age? The nervous system of the larvæ of the Tabanidæ forms an intermediate link between the Muscidæ and the Nemoceridæ.

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THE
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JUNE, 1882.

I. THE PHILOSOPHY OF THOMAS CARLYLE.*

By Constance Arden.

> "L'idée de Dieu est une forme de l'idée de l'infini."—M. Pasteur.
>
> "Le but du monde, c'est l'idée; mais je ne connais pas un cas où l'idée se soit produite sans matière."—M. Renan.†

THE distinction between deductive and inductive systems of philosophy is best represented by their practical interpretation of the terse command "*Know thyself.*" To the former it means—"Look inward; take what seems best or most beautiful in thine own mind, and proclaim that as the Law of the Universe." The latter replies—"Not so. Look outward; by unwearied research and rigorous analysis investigate the succession and coexistence of physical phenomena; then turn inward, and apply the same method of inquiry to mental phenomena, noting their observed connection with the material world; till at length all seemingly heterogeneous knowledge is welded into one homogeneous and organic unity."

Doubtless all thought is originally deductive; that is, it must begin by assuming the validity of certain primary mental operations. To reason in defence of reason is to perpetrate a *petitio principii;* to reason against reason is to commit suicide. It is also true that colours, sounds, and odours, as perceived by us, are creations of the brain,—phantoms not less ideal than the flimsiest metaphysical abstractions. But impressions which succeed each other in a certain irreversible order, coexist according to certain fixed laws, and are practically the same for all mankind, afford a far surer field for observation and experiment than those intricate, fluctuating, and apparently capricious states of consciousness, differing widely in each individual, which we denominate thought and emotion. To arrive at a sound conclusion we must eliminate, as far as possible, all mutable elements, and fix our attention upon the constant and stable residue. Having attained some comprehension of the simple and regular, we may hope in time to understand the complex and variable order of things. This is the only rational method of all true science in every age, and must be adopted by the moralist and historian, not less than by the chemist, physician, and astronomer. Only the poet may still delight us with revelations of that purely subjective truth whose evanescent glory—not visible to all, not constantly realised even by its creator—depends less upon value of substance than upon perfection of form. Poetry may be personal; philosophy (world wisdom*) must be universal. He who, in these days, forgets or wilfully ignores this distinction has failed to master the characteristic lesson of his epoch. His very earnestness will exercise a reactionary influence upon contemporary speculation and progress, by fettering living emotion to dying or dead thought.

---

* Thomas Carlyle: a History of the first Forty Years of his Life. By James Anthony Froude, M.A. Longmans and Co.

† Discours de Reception de M. Louis Pasteur. Réponse de M. Ernest Renan (Séance de l'Académie Française du 27 Avril, 1882). Calmann Lévy, Editeur, Paris, 1882.

The noblest recent representative of this reactionary obscurantism is faithfully pictured in the volumes before us. Mr. Froude has executed his tragic task in so sympathetic, yet so impartial, a manner, that we become more intimate with Carlyle than with the hero of perhaps any other biography of our century. No detail of temperament, of constitution, and of habit is unimportant, since all were factors in the growth of his mind; but our attention must here be confined rather to the completed philosophy than to its process of development. What we learn of his belief is briefly this†:—He held that all religions have been evolved from human experience, shaped by intellect, and coloured by feeling and imagination. No special revelation has ever been delivered; no special miracle ever performed. The natural and the supernatural are one, and their course is immutable. Man has in all ages created and uncreated his deities; but if gods are illusions, God is "the fact of facts." The constant forces of Nature are manifestations of the Divine will, and are distinguished as not "mechanic," but "dynamic" energies. It is not difficult to discover the general signification attached by Carlyle to these terms, although their antithetic use is radically unscientific and inaccurate. With him the machine is the antithesis of the organism, for he fails to perceive that both organism and machine are alike members of the universal Family Automata. Broadly speaking, he regards Nature as inspired, not impelled,—as a growth, not a contrivance,—his view being essentially a protest against the Theism of Butler and Paley, which finds its most noteworthy expression in the argument from Design. Analogical inferences are discarded for an appeal to intuitive sympathy. Man is not bidden to compare Nature with Art; he is exhorted to disregard detail, and to recognise in the pervading cosmical vitality a glorified prototype of his own higher life. God is no longer without, but within; no longer transcendent, but immanent. "For Matter, were it never so despicable, is Spirit, the manifestation of Spirit; were it never so honourable, can it be more?"* Earth and Heaven are the "Time-vesture of the Eternal"—no lifeless textile fabric, but a sentient garment of incarnate Deity. The Pantheism thus summarised, if lightly held as a sublime hypothesis, need not be inconsistent with scientific Materialism. It unifies the psychical and the physical,—the Nous and the Hyle,—and all beside is a mere question of nomenclature. If the dust of the earth, and therefore the body of man, is divine, no separable soul is necessary or conceivable. Save to the vulgar Dualist, who believes in an *external* Deity, it can signify little, at least in theory, whether we name our "first cause" Matter or Spirit, save that the former is a modest confession of ignorance, the latter an arrogant affectation of supreme knowledge.

---

* *Weltweissheit* of the Germans.

† See especially Mr. Froude's masterly Synopsis of the Carlylean Doctrine at the commencement of Vol. ii.

But Carlyle's mental atmosphere was dim, and the objects of his thought ill-defined, as though seen through the floating clouds of smoke which issued so copiously from his pipe. He never gained a clear vision of his own creed. "The theories which dispensed with God and the soul"—which refused to proffer explanations of what he himself had confessed to be inexplicable†—Carlyle utterly abhorred. Physical Science, and what he called the "mud-gods" of the age, he regarded with ignorant disdain; Materialism was to him the "Gospel of Dirt." A perplexed disciple might well inquire, Must we then take "dirt" as the type of

---

* Sartor Resartus, Book I., Chapter X.

† "This Dreaming, this Somnambulism, is what we on earth call Life, wherein the most indeed undoubtingly wander, as if they knew right hand from left; yet they only are wise who know that they know nothing."—*Sartor Resartus*, Book I, Chapter VII.

Matter, merely because unscientific housewives apply that name to certain disagreeable, but necessary, material forms ?* To the Pantheist dirt is a manifestation of the Deity, but the Deity is not therefore dirt. We again turn to Teufelsdröckh, who tells us, in an eloquent passage, "The withered leaf is not dead and lost; there are Forces in it and around it, though working in inverse order; else how could it rot? Despise not the rag from which man makes paper, or the litter from which the earth makes corn"; or, we might add, the brain tissues which produce human thought and direct human action, which fashion the kingdoms of heaven and earth, and evolve the forces by which both are overthrown.

The limitations and impatience of Carlyle's intellect are well exemplified by his total failure to penetrate the Kantian philosophy, and his final contempt of its "transcendental moonshine"—a truly ludicrous misnomer if applied to the "Kritik der reinen Vernunft." Yet here and there we find an insight into the subjective character of all our experiences, which should at least have kept him clear of dogmatic Animism. Many passages might be adduced from "Sartor Resartus," but it is in his private note-book that we find the least ambiguous and most authentic record of his intellectual gropings, sometimes guided by a sudden gleam of daylight, but always swerving sooner or later from the illumined path. Thus he says, in 1827, "For the present, I will confess it, I scarce see how we can reason with absolute certainty on the nature or fate of anything, for it seems to me we only see our perceptions and their relations; that is to say, our soul sees only its own partial reflex and manner of existing and conceiving."† Of course this is immediately followed by denunciation of "most utilitarians, moralists," and the whole tribe of "materialist metaphysicians." Again, three years later, he *thinks* he has finally "got rid of Materialism," to which his intellect must at one time have inclined, though prejudice strove successfully against its reception. It is evident that he felt the logical force of Hume's arguments, which at first deepened, but afterwards aided to nullify, this tendency. The scepticism of the great Scotch philosopher, which really denies nothing but the possibility of demonstrating first principles, seemed to him a deadly weapon with which he might slay the "mud-gods" and annihilate the "frog-spawn." Such German thought as he afterwards imperfectly assimilated confirmed this belief; and he never saw clearly that Materialism and Idealism play into each other's hands, and that while we are compelled, as a foundation for all subsequent reasoning, to postulate some independent Reality, or "*Ding an sich*," our total ignorance of its nature admonishes us to adopt the simplest and least imaginative terminology.*

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* Lord Palmerston's genial definition of "dirt" as "*Matter in the wrong place*" may be profitably contrasted with the nebulous fanaticism of Carlyle.

† Life of Carlyle, vol. i., p. 373.

The suggestive and in many respects beautiful fragment entitled "Spiritual Optics" illustrates this defect of vision. The fact that the Human is the parent of the Divine, that all supposed miracles have their being only in the mind of man,—as the apparent rotation of the heavens is due to the actual rotation of the earth, or as the onward rush of a landscape exists only in the brain of the traveller who dashes through it in an express train,—is insisted upon with strenuous eloquence. But in the following sentence springs up, with renewed vigour, that Hydra-headed fallacy which cannot be destroyed even by the keenest and brightest metaphors. "The delirious dancing of the universe is stilled, but the universe itself (what scepticism did not suspect) is still all there. God, heaven, hell, are none of them annihilated for us, any more than the material woods and houses." The analogy indicated here is a real one, but its signification may prove to be other than that contemplated by Carlyle. In his haughty neglect and scorn of Physical Science he missed certain elementary physiological truths, which lend a concrete basis to abstract Idealism. In what sense can it be said that the "material woods and houses" continue to exist? Around us the world is throbbing with its myriad pulses, varying in kind and in degree. These pulses strike the delicate epidermal surface of the body, and each, according to its kind, is taken up by a set of specially modified nerve structures. Here the distinctive character of the impulse is lost, and a uniform vibration is transmitted by distinct channels to distinct sensory ganglia. In these ganglia, and not in the external eye or ear, or in the world with which eye and ear directly communicate, are manufactured the trees and the solid earth which we behold, the blue sky, and the sun which illumines all. Looking yet deeper, we find that the waves of air or of ether with which we started were themselves mere intellectual representations of the unknown, fabricated in the cerebral hemispheres, and having no better claim to objective existence than the visible and tangible pageant. We must and do assume that there is "something" which exists independently of perception; but of its essence we can know nothing. If then "God, heaven, or hell, are none of them annihilated for us," they can only have their being on the same conditions as these "material woods and houses." The ideas are true so long as they claim none but ideal worth; but false when they arrogate the status of objective realities. So far from possessing any peculiar certitude, they lack even that authenticity which belongs to simple sensations, experienced by all mankind. Compounded from those impressions which are most vivid to the individual mind, inspiring the greatest terror, ecstasy, or hope, these transcendentalisms do not furnish any *rationale* of the subjective world as a whole. Other stimuli, not less real, though at present less keenly felt or less willingly remembered, are left out of the calculation.

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* It may provoke a smile to find a professed Materialist like Prof. Tyndall a zealot in this school of Gnosticism. But Philosophy or logical consistency is not the *forte* of our genial and skilled Royal Institution Empiric. Extreme pains have been wasted in explaining to him the Hylo-phenomenal theorem of Existence, which he amusingly persists in confounding with Absolute Idealism. From the standpoint of vulgar Realism he ridicules, as mere moonshine, the sole legitimate creed of Science.—See the chapter of Lange's History of Materialism in Thomas's translation "On the Physiology of the Sense Organs and the World as Representation" (Phenomenon).

Underlying Carlyle's fiery protestations of belief there was, as we have seen, a deep and constant scepticism. He admitted to J. S. Mill that his doctrines were incapable of logical proof, and shrank from conversing with Emerson upon the immortality of the soul. But, revolting against the philosophy of compromise and convention which characterises a sophisticated and transitional state of society, he confounded moral earnestness with religious faith, and supposed that the two were bound together in organic union. Had he carried the Clothes philosophy a step farther, he might have seen that "God" and "the Soul" are but symbols or "garments" of conscience, and that the thing typified can exist very well without its hieroglyph. Spiritual creeds are based not on too lofty, but on too low, a conception of Man and Nature. It is imagined that the visible and tangible is necessarily vile, unless animated by the Invisible, Intangible, and Unknowable. *Omne ignotum pro magnifico*. The vital interest of the known is held to lie in the idea that it is the mere vestibule of the unknown. Trees and flowers, beasts and birds, with all their beauty and complexity of structure, are either the living vestments of God or must be classed together as "dirt." The thoughts of man, however sublime or fruitful they may be, are priced as of little worth except as manifestations of an indwelling Spirit. The value of all is extrinsic, not intrinsic. Yet a truer appreciation of the facts of life might teach us that the supposed vestibule of the temple is really the sanctuary itself, and that all seeming vistas of further glory are only reflections of its own lustre by mirrors lining its walls. No generous action or lofty principle can be less generous or lofty because it is the coinage of a material organism. No glorious landscape can be less glorious because the mind which informs it with meaning is human, not Divine. That Nature is unspeakably wonderful we not only admit, but assert, and therefore do not seek to transcend the sphere of her wonders. Carlyle characteristically says, "That the Supernatural differs not from the Natural is a great truth, which the last century (especially in France) has been engaged in demonstrating. The Philosophers went far wrong, however, in this, that instead of raising the natural to the supernatural, they strove to sink the supernatural to the natural. The gist of my whole way of thought is to do not the latter, but the former."* The fallacy of this mystification lies in the assumption that "the natural" requires to be "raised," and that human thought is capable of such a superhuman operation. Since man can know nothing but phenomena, his first attempt to realise the noumenal makes it phenomenal, and so brings it within the domain of Nature. His imaginings may certainly be vague and incoherent; they may ignore the relation of cause and effect, and may at pleasure conjoin incongruous attributes and functions; but they cannot originate anything not already present in his own character and experience. All his ideas of beauty and virtue are drawn from mundane models, and gain nothing by being transferred to an extra-mundane Divinity. The supernatural must therefore "sink" to the natural by the mere fact that it is conceived in a human mind.

In the Address recently delivered by M. Pasteur before the French Academy, and cited at the head of this article, a similar error may be detected. He justly asserts that "the idea of God is a form of the idea of the Infinite," but does not perceive that the Infinite—instead of including "more of the Supernatural than is to be found in all the miracles of all religions," is simply a synonym of Nature. It is true that we cannot represent to ourselves any "flaming wall" as the boundary of existence; but although our conceptions of the Universe are necessarily indefinite and boundless, that is surely no reason why we should prostrate ourselves before the fetich of our own ignorance, and give it a local habitation and a name.

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* Life of Carlyle, vol. ii., p. 330.

Prayer—as Carlyle virtually admits—is an aspiration towards the "Type of Perfect" in ourselves, which is not impaired by the recognition of its subjective character. The feeling of immortality is in like manner independent of any actual future existence, and explained in part by our incapacity of conceiving any future event without tacitly positing ourselves as present spectators,—in part by that sense of immutable Continuity of Time and Space, unaffected by the succession of superficial impressions, which is experienced by all constant and concentrated minds.* The one absorbing subject of meditation is a fixed centre, which alone seems real, while the play and change of perceptions, whence we extract the notion of Time, is an illusive dream. "Thus, while eliminating the chimera of resurrection from the dead, and a sense of personal identity in other states of being, reason provides a complete substitute in the idea of immortality possessed by us in our present bodies."†

The two modes, already indicated, in which philosophers have sought to obey the injunction "*Know thyself*," are strikingly typified by the two modern thinkers, Carlyle and Darwin. The former indeed repudiated that maxim, in words though not in spirit, substituting for it "*Know what thou canst work at*;‡ but he was ever seeking to solve the higher problem of self-knowledge, and at last came vainly to imagine that its solution was in his hands. The intensity and the genius with which this belief was enforced are beyond all question, and the honesty with which it was held, spite of certain painful misgivings, is equally unmistakable. Yet it will scarcely be denied that this self-anointed prophet failed in his high mission. His converts to a virtually unintelligible and incoherent mysticism were at best equivocal, and perhaps he has left behind not one thoroughly assured disciple. He was a portent in the skies for a season; but his influence upon human welfare is not less problematic than the influence of a meteor upon the agriculture of our planet.

---

* This truth would be more generally recognised, but for that suspension of the laws of morality and common sense, as well as of physics, which seems to take place in the domain of the Supernatural. An illustration may be found in an anecdote related by Miss Martineau of Mr. W. E. Forster, the late conscientious and able Chief Secretary for Ireland. In her last letter to Mr. Atkinson (so honourably distinguished as a fearless advocate of the cause of reason and liberty of thought) she writes, "I well remember the passion with which W. E. Forster said to me 'I had rather be damned than annihilated.' If (she adds) he once felt five minutes' damnation, he would be thankful for extinction in preference." Further comment on what may be called the moral insanity thus displayed by an otherwise high-minded man is superfluous.

† Life and Mind on the Basis of Modern Medicine, by ROBERT LEWINS, M D.

‡ A formula evidently plagiarised from Goethe's 'Do the thing that lie next you.

Far different was the destiny of that great scientific philosopher whom the world has more lately lost. Patient, modest, impartial, Darwin was not content to cross-examine Nature, and to interpret her answers in accordance with his own prepossessions; but he lived in communion with her, and disdained none of her dwellings because it was common or unclean. Every truth thus brought to light he regarded not as a solitary phenomenon, but as related to all other truths, known and unknown, and sought—still by the same method of experiment and research—to discover the grand generalisation which unites all particulars. The mind of Carlyle was medieval and theocratic, imbued with the parental Calvinism, which was practically embodied in his matured thought; that of Darwin, on the contrary, was essentially secular and modern. There was no place in his system for that remnant of Animism which Christian admirers would fain interpolate.* He himself could never have cherished the "sure and certain hope" expressed over his grave, nor could he have harboured any fear such as one would think must sometimes haunt even the clerical mind when it meditates upon the "future state" of unorthodox savants.

The theory of Natural Selection owes its epochal character to the nature of the evidence adduced in its support, and affords a perfect example of the potency of induction and the impotence of *à priori* reasoning. From the earliest times Evolution has been a constantly recurring commonplace of philosophy. Without referring to early Greek speculations, we may mention the names of Descartes, Leibnitz, De Maillet, Goethe, and Lamarck. But the principle was fruitless, because rootless. The data on which it was based were inadequate, and often fallacious, thus constituting an ingenious hypothesis rather than a sober thesis. The idea remained sterile for lack of verification. As soon, however, as fresh facts supplied this essential element of scientific demonstration,* Darwinism became a power which profoundly modified the direction and line of modern thought. In every department of knowledge its influence is manifest.

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* See the Sermons preached on the occasion of his death by the Bishop of Carlisle, and by Canons Liddon and Farrar. The absence of any representative of the Royal Family at his funeral seems to imply that clearer vision is possessed by the hereditary Head of the English Church. A similar insight into the heterodoxy of the Darwinian theory was displayed by the Archbishop of York, in a Lecture delivered in St. George's Hall, May 25th, 1871. For a forcible criticism of this Lecture see the first of a series of tracts written by a well-known scholar and divine, under the pseudonym of JULIAN, for whose work Dr. Lewins stands sponsor.

The moral is clear, the contrast significant. Instead of docilely surrendering himself, like Darwin, to the guidance of truth, Carlyle erected his own subjective standard in the fore front of the battle, and expected truth to follow his lead. In the pre-scientific "ages of Faith," the use of such a method was, if not a positive virtue, at least a venial sin; but at the present day it is an actual crime against Human Nature, and involves a corresponding Nemesis. Carlyle despised the spirit of the age; but the age had its revenge, and he his reward. Like the forgotten theories of Evolution, his anachronisms only represent one phase of a primæval, but quite obsolete, ideal, to which they fail to impart any fresh vitality. They, too, are without root, therefore without fruit.

II. CHARLES DARWIN: A FAREWELL OFFERING.

By An Old Disciple of Lorentz Oken.

"THE gods leave us!" We sit as if stunned by a heavy and unexpected blow, and time must pass before we fully realise what we and the world at large have lost on the 19th of April. We can scarcely believe that we shall never more open a new book from his pen, throwing a clear and startling light upon some hitherto unsolved question, or drawing important conclusions from facts heretofore ignored or despised. Many a student, many an explorer in English museums, in German laboratories, in Brazilian forests, or on Malayan coasts, when coming upon some suggestive phenomenon, will forget for the moment what has happened, and say to himself "I must let Darwin know this!"

We were all aware that Darwin was well advanced in years, and that his health was far from robust. But so necessary had he become as a leader to all earnest cultivators of Natural History that the probability of his end was dismissed as too painful to contemplate. We may, indeed, say to each other that his life-task was accomplished—that the doctrine of Evolution is, in its broad outlines, accepted by almost all men who are intellectually and morally capable of judging, and there but remains for his successors the easier though honourable task of working out in detail what the Great Master had planned.

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* Not by Darwin alone, but also by Lyell, Haeckel, Wallace, &c. The first-named, who proved the unhistorical character of Genesis, sleeps in Westminster Abbey; of the second—pronounced Materialist though he be—Darwin has expressed the most decided approbation.

Such consolations, however, seem at present almost cynical. We could all have wished that he might live on to enjoy the triumph he had won; to see the Church and the World yoke themselves side by side, as is their wont, to the chariot of success; to witness his former opponents feasting on their own words, and, best of all, to give to his followers those wise and kindly words of encouragement, of advice, or of caution, which will be remembered by many a student, and which no man living is equally competent and entitled to offer.

It is certainly cheering to note that much of the ill-will felt and the abuse uttered against the mighty dead has faded away. The "Origin of Species" is no longer classed in the *Index Expurgatorius* of the Church of Rome, which, by the way, has never formally condemned the doctrine of Evolution, and which will probably be the first of the great religious bodies to conclude a peace with the New Natural History. M. l'Abbé Moigno ("Cosmos les Mondes," April 15th, 1882, p. 580) even complains that the Academy of Sciences had closed its doors so long against "la grande, la noble figure de Darwin, parceque le système de l'Evolution n'etait pas assez orthodoxe."* Nay, we witness a strange sight: theologians and anti-theologians are respectively claiming the illustrious departed as one of themselves in a manner that recalls the mediæval legends of wars waged between angels and demons over the remains of some eminent saint. Says Canon Farrar, in a sermon preached on April 30th, in Westminster Abbey, "As a boy Darwin had been under the influence of deeply religious impressions, and there was evidence that he never lost those impressions." The preacher found in all the writings of the great naturalist "no word irreconcilable with faith in Christianity." Very similar is the contention of Canon Liddon.

On the other hand, Dr. E. B. Aveling insists that "no one knows the truth in this matter who calls the Charles

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* This was a mere pretext on the part of the Academy. I suspect that the jealousy of certain of its most active members was the cause of the delay in recognising Darwin's merit.

Darwin of later years a Christian." A certain *doctrinaire* weekly organ, noted for its anti-vivisectionist leanings, records that Darwin's system has "no room for special providences or the doctrines consequent on this dogma." The writer, perhaps, forgets that the very same charge has been urged against Newton, and, due allowance being made for the difference of the subject, with equal show of reason. Fortunately it is not my duty, nor that of the "Journal of Science," to adjudicate between the saints and the sinners. That such a contest should have been raised over Darwin's grave is the best evidence of his greatness. But I cannot forget how very recently the Churches which now claim him were denouncing him, not merely as a heretic and an atheist, but as one who intentionally and consciously sought to sap the religious convictions of mankind. It is scarcely seven years since the Rev. F. O. Morris, a clergyman of the same Church as Canons Farrar and Liddon, in a pamphlet entitled "All the Articles of the Darwin Faith," put in the mouth of him whom we have just lost these very words:—"I have done all I could to make others as wretched as I am myself; I do my little best or worst to shake their faith, &c." Nor has the spirit which breathes in the lines just quoted entirely subsided. Says the "Univers"—"When hypotheses tend to nothing less than the destruction of faith, the shutting out God from the human heart and the diffusion of the filthy leprosy of Materialism, the *savant* who invents and propagates them is either a criminal or a fool. *Voilà ce que nous avons à dire du Darwin des singes.*" I certainly will not ascribe to the staff of the "Univers" a descent from apes; I should rather trace their pedigree direct to the Harpies of classic saga. Assuredly they have most wonderfully retained the ancestral habit of defiling with their *fœdissima proluvies* everything worthy of honour. Leaving, however, the "Univers" as a matter scarcely fit to be even spoken of without apology, and ignoring "La Patrie,"—less foul, though no less deluded,—let us look at home. Have we as a nation treated our great countryman, in life and in death, in a manner upon which we can look back with satisfaction? Fortunately for himself, and still more fortunately for the world, he was a man of independent means,* and hence invulnerable by the favourite weapon of modern persecution. But had he been like his father, a physician, would not his patients have been duly warned not to place themselves in the hands of so "unsound" a man? Had he by some evil star been the head-master of an endowed school, or had he held a professorship in any British university, would he not have received from those in authority a hint to resign? In any profession he would—to use one of the unhappy words of the present day—have been "Boycotted." Even when the storm of abuse and misrepresentation ceased, we had still no mark of public recognition for the greatest naturalist the world had ever known,—for the man who had made England the focus of Biology, and won for us, single-handed, the hegemony in Science. Ministries went in and out; Tories succeeded Liberals, and Liberals followed Tories, but neither party recommended him to the Sovereign as one whom it would have been a privilege to honour. Even when he was being laid to rest in that fane which holds the remains of no superior, and of few, if any, his equals, Royalty was unrepresented! I admit that Darwin—the very type of the quiet, modest, unobtrusive worker—would have set but small store on titles and orders, and that perchance he might even have declined them if offered; but for the credit of the nation, for the sake of the toiling student in every branch of Science, the offer should have been made. Never again may we have such another fellow-countryman to honour! For we must bear in mind that he was in almost every point, if not un-English, yet "un-modern English" in character and calibre. He stands in full and sharp contrast to the men before whom we bow down in reverence. Perhaps we should have appreciated him better had he been a child of the platform, greedy of opportunities for speech-making, instant in self-glorification, and prone to spice his writings with the cant of the day. It is necessary to dwell on this point for a moment, in order to understand the man who has passed from among us. As a people, we Englishmen of the latter days believe in expression rather than in conception, in rhetoric and sophistry rather than in philosophy, in words and dreams rather than in thoughts and things. We are "Geister die verneinen." We deny, dissent, disunite, and destroy. We delight in "anti" movements, leagues, and societies. Our national religion is a "protest"; our historical policy has for centuries been content to oppose what France proposed. Out "advanced thinkers" and "reformers," social, political, or theological, rarely rise above the level of barren negation. Having disproved some old dogma, overthrown some ancient institution, removed some landmark, they claim and receive worship, and leave the greater and better task—that of creating and originating—to the mercy of accident. It is significant that the terms "reform" and "destruction" are becoming synonymous. Darwin, on the contrary, was not the "reformer," but the "reformator" of Biology. This character appears in his method of propagandism. He did not go about criticising and attacking the dogmas of the Old School, the doctrines of special mechanical creation from without, of the perfection of Nature of final causes in the animal and vegetable structure, and the like. Just as Bacon superseded the Aristotelian and Scholastic Philosophy, without deigning to enter into what might have been an endless and profitless logomachy, so Darwin spent little time in exposing the errors of the party then dominant. He did not seek to refute Agassiz, Cuvier, Paley, Linnæus, Davy, and the like. His task was to affirm and to create. It is well also to note that the same character prevails in the doctrines of the Evolutionist School. Cuvier and his disciples had held the creed of Catastrophism. According to them a great abrogation, "reform," or destruction took place every few thousand years, thus making *tabulam rasam*, and getting rid of the past with all its features and failings. This is the outcome of the negative, the "anti"-spirit. But Darwin has shown us that the great changes of Nature are effected in a different manner. The old is not destroyed at haphazard. New forms gradually spring up, supersede it, and take its place. Here, then, we have the creative, the affirmative, the originating spirit. It would be instructive and far from difficult to show that Darwin's style of controversy, if we may so call it, is at one with the doctrines he upheld, and with the processes which we see working in the world around us.

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* Is it not worth noting that, like Darwin, Lyell, Buffon, Lamarck, Humboldt were gentlemen? Is, perhaps, hereditary culture necessary for the great generaliser?

Need we therefore wonder if his researches and his writings were a stumbling-block and a stone of offence, alike to the bigoted adherents of the past and to the no less bigoted votaries of destructive changes?

Charles Darwin has been likened to the great man at whose side he sleeps, and who perhaps may be regarded as his only fitting companion in death. Both these sages have done more, much more, than merely re-organise—or rather create—some special science. Newton gave us in substance the astronomy and the natural philosophy of the present day; but he convinced mankind of the immensity of the universe;* he familiarised the world with the conception of unvarying "law" (I use the term reluctantly); he showed us matter, not inert but active, and brought us nearer to the insight into its atomic constitution. The philosophic bearings of these onward steps do not need to be traced in detail. A new horizon was opened out to man, and the entire current of his thoughts was bound to undergo a change in as far as the teachings of the great astronomer were understood and assimilated by the people. That for this good service Newton was denounced almost as warmly and as roundly as Darwin need surprise no one.

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* Completing the task which the great Italians, Galilei and Giordano Bruno, had begun.

Charles Darwin undertook a task more difficult from a threefold point of view: the subject-matter with which he had to grapple was in itself far more complicated and manifold; it was in a much more crude and imperfect state; and it was more subject to the interference of human passion and prejudice. It is not too much to say that—despite what had been done by Buffon, by Lamarck, Erasmus Darwin, St. Hilaire, and Oken—zoology, botany, and palæontology scarcely existed as sciences. The great men just mentioned had given indications of value, and had pointed towards the truth, but the world refused to listen, or heard merely to ridicule. The hour was not yet come, and the evidence collected was not sufficient. In the received text-books of natural history—the writings of Linnæus, Goldsmith, Cuvier, and the like—we found descriptions, indeed, of species, genera, and families, arranged in groups more or less unnatural. But if we asked why certain forms were present in one country, and not in another possessing an identical climate; if we wished to know whether extinct species should be introduced into surviving genera; or, in short, if we raised any of the thousand questions which every Science must answer if it seeks to make good its character as a body of correct, systematised knowledge, our teachers shook their heads and called us "närrische Jungen." If devout, they referred all these points to the inscrutable will of God: if sceptical, they accounted for everything as the outcome of "chance," and showed a plain dislike to such questioning.* But even "närrische Jungen" and "coquins curieux" could feel that a body of learning which merely appealed to the memory was no Science.

As to the prejudices of the public, they were such as the rising generation can scarcely comprehend. Men were willing to admit that in the movements of the planets—as in the fall, the motions, and the encounters of bodies upon the earth's surface—there was nothing mysterious, unaccountable, or arbitrary, but merely a series of causes and effects capable of being foretold as soon as all the conditions of the case were fairly stated. But to make similar concessions with regard to the organic world* is to see the arbitrary imperilled in its last stronghold. Hence we may understand, if we cannot altogether excuse, the rancour stirred up by the "Origin of Species," and still more by the "Descent of Man." The blow given to human vanity and egotism could not be forgiven. We see, too, what Darwin has effected. He has not merely given to Natural History internal coherence, method, and object; he has made the reign of law complete in every class of phenomena; he has opened to the world a still wider horizon than that disclosed by Newton—a horizon which extends over the domains of psychology, social science, and philosophic history, with the arts founded thereon. It is doubtful if so widespread and so thoroughgoing a revolution was ever before effected,—effected, too, not by the destructive but by the constructive method. On this ground therefore, and quite independently of his special merits in Biology and Zoology, I claim for Darwin a philosophic rank never surpassed.

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* Let no one think that I here allude to Oken.

An eminent scientific man, and a personal friend of the departed, has recently compared him to Socrates. I can trace between the two thinkers few points of likeness, but rather a most striking contrast. If we look to their respective methods we find in Socrates the busy, prying gossip of a great city,—questioning, discussing, seeking truth from men, from words, and from notions and modes of thought. Nay, at times he would seem more anxious to confute than to instruct either himself or others. Darwin, though kindly and genial among friends and fellow-labourers, was the silent, patient, solitary inquirer; haunting not the streets or the market-places, but the woods, the shore, the deserts, the mountains, the garden, the laboratory; examining facts, caring little what names had been given to them by the ignorant, or what notions had heretofore been formed anent them. He was the observer, the experimentalist, the man of things as decidedly as Socrates was the dialectician, the man of talk! Had the latter lived among us he would have received not a draught of hemlock, but a peerage—perhaps the Premiership.

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* It is strange and sad to note how we allow ourselves to juggle and be juggled with the words "organ," "organic," "organism," &c. If any one formally asks us the meaning of "organ," we refer him to the Greek lexicon, where he will find *'Organon* rendered "a machine, a tool, an instrument." But the next moment we forget all our etymology, and speak of the organic as a mysterious antithesis to the mechanical. The Dutch more happily make use of a word "understanded of the people." They call an organ "werk tuig" (= the German "werk zeug", and "organic nature" they term simply "*de bewerktuigde natur.*

In the subjects of their respective studies, and in the results arrived at, the difference is even more striking. It cannot be denied that Socrates drew off attention from Physical Science. He was a despiser of Nature—of everything visible save man, and it may even be said of the human body. He formally initiated that great aberration which rendered the Greek philosophy of the latter ages so utterly unworthy of its hopeful dawn in the days of Thales, Democritus, Heraclitus, and Empedocles, which culminated in the first centuries of the Christian era, and which even yet is far from having come to an end. Men were not merely ignorant of Nature (pardon the personification); they despised and refused all physical knowledge. The words which Goethe, in the second part of "Faust," puts in the mouth of the Archbishop-Archchancellor—

> "Natur und Geist! so spricht man nicht zu Christen;
> Deshalb verbrennt man Atheisten!"

are a faithful expression of the manner in which the natural sciences and their subjects were regarded in the dark ages. We find in Socrates the germs at least of that separation of man from Nature as a something altogether heterogeneous, independent of law, of the sequence of cause and effect, and not to be introduced into any classification of the organic world. We even yet meet with such expressions as "the kingdoms of Nature and of freedom."

Among the consequences of the Socratic movement may rank all the persecutions of Science from actual executions and imprisonments, in the good old times, down to the contemptuous ill-will of so many poets, historians, novelists, journalists, metaphysicians (? anti-physicians), and fast literary men of this nineteenth century.

In the life labour of Darwin we find all this reversed. He not only showed that Nature was better worthy of study than the words, the quibbles, and the dreams of men,—in so doing he, like all followers of Science of whatever grade, simply carried out in action what Bacon had taught in precept: but he did more; he showed that man is an integral part of the organic world, capable of being understood, physically or psychically, only when regarded in that light. It has been well said that Galileo, rejecting one of the foolish antitheses of ignorant ages, "restored earth to her place in the heavens!" With equal truth it may be said that Darwin, overturning another vain antithesis, has restored man to his place in Nature. Who can exaggerate the philosophic import of this one result—the reversal of what had been attempted by Socrates and his followers, whether Pagan or Christian, mystics or dialecticians?

In one particular point Darwin's example must be ever precious to the student. He never overlooked or despised small things. Inferior minds stray about in search of some grand, startling phenomenon, ready and willing, doubtless, to put it on record if it would only come in their way. But one of the secrets of Darwin's strength was the conviction that the continuous and ubiquitous action of apparent trifles effects more than do exceptional and catastrophic displays of power. Never was this lesson exemplified in his whole life so ably taught as in his last book on earth-worms.

He has been accused of a lack of originality, and even of injustice towards his forerunners. True the idea of Evolution was not for the first time broached in the "Origin of Species." But who, save Darwin, gave the unpopular doctrine coherence? Who collected the wonderful mass of evidence needed for its establishment, and won for it the general acceptance of the scientific world? Darwin alone. Mr. A. R. Wallace, the co-discoverer of the hypothesis of "Natural Selection," not merely admits, but avows, Darwin's superior claim. Where Buffon, Lamarck, and his own grandfather Erasmus failed to carry the world with them, he has succeeded. Hence, according to the invariable rule which awards the palm not to the suggester, but to the establisher of a truth, Charles Darwin must be hailed as the founder of the New Natural History.

Of his caution, his conscientiousness in laying before the world all facts opposed to his own theories, everyone must be fully aware. He was often his own most formidable opponent, and his gainsayers, with characteristic truthfulness, would pick certain passages out of his works, and parade them, detached from their connection, as proofs not of candour, but of vacillation or inconsistency!

With respect to the long delay in the appearance of the "Descent of Man," Darwin has been charged with reticence verging almost upon insincerity. The accusation does not, to me, appear warranted. Our great naturalist was one of the most circumspect of theorists. Even the "Origin of Species" was long kept back, while the author was accumulating further evidence and weighing its import. It is therefore, in my opinion, only natural that he should show the same circumspection on taking a second step, which, if logically involved in the first, did not seem so to the outside world, and which indeed separated his position from that of Mr. Wallace.

Will the doctrine of Evolution retain its supremacy, or will it fade away as rapidly as it has arisen?

As regards general principles we are as likely to return to the physics of Aristoteles, to the astronomy of Ptolemy, or to the chemistry of Beccher and Stahl, as to the natural history of Cuvier. Changes of detail, in proportion to the complexity of the subject, may be looked for. It is highly probable that Natural Selection will occupy a less prominent position among the agencies determining the development of organic forms than Darwin seems to have at first considered. But such re-adjustments and additions will neither lessen the merit and the reputation of the man nor affect the world-wide influence of his conclusions. It is something to have been the contemporaries and the countrymen of Charles Darwin, and to have held even the humblest place among his followers.

III. VEGETABLE SOIL.*

By G. H. Kinahan, M.R.I.A., &c.

OVER ten years ago, in the pages of the "Geological Magazine," I published papers on the "Growth of Vegetable Soil" (1869, vol. vi., pp. 263 and 348), while in 1875 the same subject was gone over in the appendix of "Valleys and their Relations to Faults, &c." In those writings what Darwin had then published in reference to earthworms was mentioned and discussed; while evidence was given to show that this eminent observer appeared to ignore too much the soil due to vegetable growth and decay, and the work done by ants and other disturbers of the soil. It seems as if Dr. Darwin is unacquainted with these writings, as in his recently published book on "Vege-

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[*] This paper was written prior to the death of the eminent philosopher, Dr. Darwin, and was ready for the press when his lamentable death was announced, which consequently delayed its publication.

table Mould and Earth Worms," he does not refer to any of the facts therein stated.

It appears unnecessary in this paper to repeat the facts already published in the writing above referred to, but it may be allowable to record facts since collected, especially those that bear on some of Dr. Darwin's statements, and to comment on some of the latter.

From my observations it would appear that the Irish worms are not *all the year round workers*. They generally begin their main work in September and work up to March or April in wet, soft weather, as frost or the like completely stops them. In March and April as a general rule they do very little surface work, while in April, May, June, July, and August they seem to be principally employed, if there is rain, in migrating from one place to another. But if it is dry, as is not uncommon in May and June, they retire to the deepest part of their burrows, coil themselves up, and go to sleep until the heavy showers of July come on, which penetrate down to them and gives them new life. The migration is not, however, confined to the summer months, as between September and April, during soft warm rains, they migrate considerably; to this, however, we will have to return hereafter.

These general remarks refer to the worms in the open, because in some enclosed damp place, such as walks under trees, court yards, passages, and the like, they appear to be at work oftener than elsewhere; but I do not believe that in any place they work *all the year round*, and any calculations based on such a supposition must be more or less erroneous.

The interest Dr. Darwin has taken in the earth worms seems to have prevented him observing what other animals, especially the ants, can do; and what appears very remarkable, in the writings of such an eminent and acute observer, he apportions to the worms, as will be afterwards mentioned, work that evidently was done by ants. Ants in Ireland work for about five months in the year, and during that time a colony of even the smallest kinds heap up a considerable amount of soil, while some other kinds make conspicuous hillocks; their work, however, is a mere bagatelle to the hills raised by some of the foreign ants. It must, however, be allowed that as the ants usually work during the time when grass and other herbs are growing, the work done is consolidated and kept together, and the full amount of work done is thus recorded; while earth worms only work in wet weather, at times when vegetation is slack, and consequently much of the soil they produce is carried away and scattered by rain, runlets, and the wind.

Ants and earthworms do not work together or in general in the same kind of ground; and I strongly suspect that if surveys were made of the Irish lands where the earth worms do work, and where the ants do work, that the area of the latter would come very nearly equal to that of the first, while the soil in the ant hills would considerably exceed that in the worm casts. After these general remarks we may proceed to give some more minute details.

Worms and Grass Land.

While giving facts in this and the following divisions, a plan somewhat similar to that of Dr. Darwin's may be adopted, exact time and place being recorded; and first may be mentioned what has taken place under nearly daily observations. I am now living in a low-lying damp valley, Vale of Ovoca, Co. Wicklow, and when I came here five years ago the croquet ground was covered with a five inch thick bed of moss, the place having been uninhabited for over three years. To get rid of this moss in March, 1877, whins were heaped on it and set on fire, which burned off all the vegetation. No worm work was observed on the croquet ground until the September of 1879, after the grass began to form a regular sod. In 1880 the autumn and winter was very frosty, and the worms did very little work, but last year the autumn and winter (1881 and 1882) were very damp, and the worms have been at work nearly continuously from the end of September till February 1882. In 1881 the croquet ground was mowed early in April, and from that time till the end of September, when the wet weather stopped the lawn tennis, I did not observe a worm casting. From September, 1881, to March, 1882, the worms were very constantly at work in moist weather, especially on the worn places stopping off for days when there was no rain. On the sixth of March the croquet ground was rolled for the first time, and about once a fortnight afterwards, and after the first rolling few or no worms put up castings. The few that did were on the bare spots; they seem to have thought that the dry weather was come, and that they ought all to go to bed as they usually do in the dry weather of May and June. In the first week of April and again on the 15th, there were severe frosts, and in the rain before each there were casts, as if the worms in the grass had anticipated the cold and had left the grass tufts and again returned into the ground.

One of the adjoining walks had its edges neglected for about eighteen months, during which time the grass had encroached on the walk for from two to five inches. Three perches of one of the edges I cut myself during the first week in October, carefully examining the sods, in which I found ten seedling worms, some so small that they could scarcely be detected, and one large worm. Afraid some worms might be buried I examined the place carefully for two weeks, but not a worm came up, although the weather was most favourable for worm work, as could be seen by the daily new casts in the adjoining grass.

Many of the walks were made of "mine gravel," in which weeds will not grow, or worms burrow or creep across. In the autumn of 1880 one of these walks was coated with river gravel, and during last summer and autumn it became coated with grass, and in this grass I could not detect a worm cast or a worm when the walk was scuffled and cleaned in January. Another walk was carted over in the winter of 1880, and when cleaned in the spring, some patches of clay were left on it. On these I observed worm casts in October, which were examined, and I found that none of the worm burrows went below the clay, although on an average the patches were not more than half an inch thick. These facts appear to suggest that the growth of soil on walks and such like is not much due to worm work.

On a clayey, shady walk along the south hedge of the garden, and partially overhung by trees, the worms usually throw up cast for from seven to eight months in the year, but never in great numbers at a time.

This winter (1881—1882) has been exceptional for studying worm work in this country, as they have been able to be nearly continuously at work from the time they began in the end of September, there having been only one week of continued frost and a few other odd days that prevented their working, while in general the weather was warm and moist. Even in places where they seldom do much work, such as the upper heathery, grassy slopes of the hills, worm work this year is so conspicuous that the natives remark it, and state that there are ten worms for one of an ordinary year; the casts also are much larger. In such a field in Glenow, Co. Wicklow, about 800 feet above the sea, I found them exceptionally numerous and large, there being on an average eleven casts to the square foot, average ones having diameter and height of about 2·5 inches, while some had diameters of over 5 inches, and exceptionally tall ones had heights of 6 inches, the latter usually having small diameters of about 2 inches, These large casts are evidently due to the mild weather, because as fast as the earth is thrown up the grass grows in it and prevents it being carried away by rain, runlets, or the wind; thus each cast appears to represent the *entire* work for the season (four months). For the four months' work in this field there has been an average of about 44 cubic inches to the square foot cast up, and if we suppose that on account of the exceptional year this is ten times the average we would have for ordinary years about 4 cubic inches to the square foot, which multiplied by 30, as the land was laid down about the year 1850, would give 120 cubic inches to the square foot, or about 0·75 of an inch added to the depth of the vegetable soil in thirty years.

The worm work in this field, as just pointed out, was excessive, so that probably 0·5 inch in the thirty years would be more correct. In either case if Dr. Darwin's theory is correct, the worm work ought now to give a considerable depth of soil, but what is rarely the case, the soil on these hill slopes rarely exceeds 3 or 4 inches in depth and often is less, and this has been the average depth for fifty years or more, the vegetable growth and decay being at a minimum. Furthermore, on following down the worm burrows they are found to be systems of nearly horizontal burrows backwards and forwards through the vegetable soil immediately over, and in no case penetrating into, the subsoil. As I pointed out in one of my previous papers, the Irish tillers of the soil usually cultivate over and over again only one stratum, and in this area it is found that in the more recently laid down land the worm burrows are principally at the bottom of that stratum, immediately above the subsoils, as if their tunnels had been made in, and in search of the decayed vegetable matter due to the turned down surfaces of the old sods. The facts observed would seem to suggest that the worms do not take from the subsoil to add it to the overlying stratum, but that they rearrange, over and over again, the vegetable soil. These notes specially refer to the slopes of the hills adjoining Glenow, but from the observations made they are also more or less applicable to the whole of the County of Wexford, and part of the County of Wicklow, let it be upland or lowland, the latter naturally having a greater depth of vegetable soil in which only the worms tunnel, unless its depth is increased by artificial means.

During the last week in March, 1882, I explored an artificial mound in a prehistoric *feartha* or burial place; worms were in the first spit (about 6 inches), but under it there were none—so much so, that one of the men remarked hat "it could not have been placed here, as there are no worms in it." Before he spoke, as I was carefully watching every bit turned up for relics, I had myself observed the total absence of worms, which even now surprises me, as apparently the soil was very suitable for their work.

In grass during the summer, but especially in meadow land, worms seem to throw few or no casts. In the winter they have to burrow, because there is no vegetation to protect them from the cold; but this is not the case at other times, as they find sufficient shelter in the crowns of the grass and other growing plants. Go into a growing meadow with the ducks of an early morning or after rain, and you will find innumerable worms creeping about, which, as the ground gets dry from the sun, retreat, not, however, into the ground, but into the crowns of the plants; even in the summer pasture land, except when it is eaten very bare, worms in general are able to find shelter without burrowing.

I may be allowed to point out that, in making a calculation of the quantity of earth thrown up by worms, it is not correct to be always removing it, because the oftener it is removed the more vigorously they work. Leave a worm cast and a worm may not add to it for weeks, but clean away his cast day after day, thus letting the rain or other moisture into the burrow, and night after night he will cast up new earth works.

Many or most of the fields on the Wicklow hill slopes, if the rocks are slate or the like, tend to run into moss; this tendency to run into moss being very common in such areas and a great nuisance to the farmer, as it necessitates his breaking up the land. In none of these mossy fields will worm casting be found except on the tracks made by carting across them in the autumn. Where do these worms come from? Often one of these tracks will be a mile or more in length and all along it there will be numerous castings, while not one worm can be detected in the adjoining mossy fields. They may be in the moss but I could not detect them, which I ought to have been able to do, as it is not an uncommon practice to mow off "the fog," as this moss covering is locally called, and use it for the bedding of cattle, yet search the newly mown "fog" and no worms appear to be in it. It is, however, quite possible that they may have come out of the moss, because even if they were few and far between, if all of them were to migrate out of it to the sweet herbage on the beaten track, the number from the large area of moss land would appear excessive when congregated on the very limited space occupied by the track.

Worms and Tillage Land.

In the loose tillage land the worms appear to be able to run through it without having to throw up casts. In potato tillage you plant in February, March, or April, and afterwards you dig the furrows and earth, while you dig out about October. From the time you plant until you dig out you rarely see a worm cast on the surface, yet when you are digging out, the worms will be most numerous. In turnip and such like green crops, if the crops are allowed to lie long in the land, you will find some worm casts between November and February, according to the time the land is broken up, but not many if we are to judge from the few to be seen last winter (1881—1882). Yet there were plenty of them in the ground, as could be proved by digging it up, or by the innumerable surface tracks after rain. Here it may be mentioned that it would seem as if it is only from necessity they burrow, because after a turnip or mangel crop is pulled, numbers of the worms will be found under the leaves or any other kind of vegetable matter that has been left on the surface. Beans are sown in the early winter and pulled in the early autumn; usually "bean stubble" is very dirty, and when broken up is found to be full of worms, yet worm casts in bean land are few. Wheat, barley, and oats land rarely have worm casts on them, except when clover or hay seed have also been sown to lay it down. In March and April, 1882, I carefully examined the land on the Wicklow, Wexford, and Carlow hills (schist rocks), laid down the previous year, and rarely could I find a worm casting, the land not having consolidated and the worms being easily able to pass through the earth without throwing up surface mounds. On some of the land laid down two seasons there were a few but not many; the conspicuous areas for worm castings being the old consolidated grass field on which moss had not grown.

I had some land in which celery grew, which was dug up early in January and let lie till April; not a worm cast was to be seen on it, but when dug up the second time, the old manure, a spit under the surface, was full of worms.

In my present garden at Ovoca, an open one, which has a hedge and trees round three-fourths of it, I usually have two crops of early cabbage—one put down in October and the other as early as possible in February or March. The cutting of the first crop, if the weather is favourable, will be in April and May, while all will be cleared out in June or

July. While these crops are growing no worm casts are visible, but if kind rain comes on at any time, innumerable small worms appear that come up out of the ground without making casts and congregate in the young cabbage. These worms are very destructive, for although you cannot detect any eating away of the plant, yet the cabbages affected by the worm gradually dwindle away. This season (1881-2), on account of the heat and moisture, this class of worms were in excessive numbers, and so injured my October planting that the bed had to be nearly replanted in February. Not a cast will be seen on such ground, but when it is dug up after the dry weather in May and June, numerous worms will be found in the roots of the cabbage stalks, or coiled up in roundish holes from eight to fifteen inches below the surface; the latter are quite attenuated, as if they had been hybernating for some time. This occurs if you dig the cabbage beds during the dry weather usual at that time, but if you wait till the July rains come, none of the worms coiled up in the cells will be found. It is, however, quite possible, on account of the surface of such ground being friable, that worm casts are hard to detect on it, they also being friable and easily dissipated by very slight moisture; nevertheless, I suspect from what I have seen of worms that it is only through necessity that they make casts, that is, when the ground is so compact that they have to excavate tunnels through it.

The Travelling Worms.

Earth worms appear to be great travellers. After rain examine ground on which the tracks will remain, such as a road, and see the number of them and the excessive length of some of them. The tracks on a road are of two distinct kinds, one making a straight furrow and the other, although going straight, having a wriggled aspect. Examine the tracks on a road any morning after rain and the worms appear to have started from the grass at one side to get to the grass at the other; but as they rarely leave the grass exactly perpendicular to the road, their track tends more or less obliquely across it. They, however, go on straight until they meet an obstacle, from which they go straight till they meet another, so that by these different changes from their original course they often have gone 300 yards or more before they got across a road 10 yards wide. Rarely does a track run across in the shortest line, because, in addition to meeting obstacles, if there is a fall in the road they tend to go down it more or less, sometimes going straight down the centre, while if it is level they appear—like a man walking—to side to the left hand. Sometimes when they meet a lot of obstacles they appear to have got completely bothered, and in the end to have returned to the side from whence they had started.

Worms evidently require moisture to travel; whether they travel or not every wet night it is impossible to say from the tracks, as the track may be obliterated by subsequent rain; but if there is rain in the early night the roads in the morning will have numerous tracks. After rain on a road during daylight I have rarely observed worms travelling, and that only in very sheltered places, while during dews they do not appear to travel across such places, but on land clothed with grass or other vegetation they travel in dews at night, and both by night and day after rain. The ducks know this, and in summer go looking for the worms of an early morning or after rain in the day time. From what I have observed I suspect the worms do not travel during heavy rains; it is usually in the damp heat after the rain that so many of them are about.

I have not as yet been able to learn why some tracks are smooth and straight while others are wriggled like the annelid tracks on the coal measure flags, but I suspect the wriggled tracks may be made by a different variety of worm. Usually, the worms I have watched travelling, let them be long or short, went straight, each forward movement being two-thirds the length of their body; the rate of travelling being due to whether they extend and contract the body quickly or slowly. If a worm comes to a space such as a hollow between two flags, he feels across it with the point of his body, and if he can catch on with that he will draw himself across; but if he cannot feel the other side he keeps screwing up the one-third of his body to try and elongate himself; thus often when the space to be crossed is too wide he will overbalance himself and fall down into the hollow, and if the latter is a stream or pool of water he will probably be drowned.

It has been previously mentioned that when worms set out to travel they go straight forward if they meet with no obstacle; the temporary rills and stream of water after a shower they do not appear to class among the latter, as nearly invariably they try to cross them, and thus many of them perish, they being carried down by the stream into one of the shallow pools, where afterwards numbers of them will be found dead. Many worms are also killed if the early portion of a night is wet and afterwards there is a frost, they being caught and killed by the cold while trying to cross an exposed place such as a walk or a road. Too much heat will also kill them, as during one of those hot showery days in March last (1882), I was watching some worms crossing an open shrubbery walk, and if the sun came out suddenly and strong immediately after one of the showers some of the worms were sure to give up and lie down and die. I have also observed that on one of those hot, bright, sunshine mornings not uncommon after a wet night, many dead worms will be found on walks and such like exposed places.

Yet worms appear to be capable of travelling with great speed. In "callows," or the low-lying lands along rivers and lakes, and liable to be flooded during the rainy season, the worms appear to be able to retreat as fast as the flood rises, because at the margin of the flood they will be nearly innumerable. They also appear to be able to follow the flood as it rises and falls, and this is well known to the ducks, plover, and other wild fowl that here congregate,—not, however, solely to feed on the living worms, but also on the bodies of those that were caught by the flood, and swept by it on to its margin; but if you examine the grass at the margin of a flood, the live worms seem to far exceed the dead ones, except in the case of a perfectly bare callow, when the dead ones may be in excess.

Worms when travelling, if they meet with an obstacle rising suddenly before them, go round it if possible; while if there is a sudden fall in their path, as before mentioned, they may fall over it: thus numbers are drowned in drains and other water-courses with steep perpendicular banks. When draining land it is a common practice to test the efficiency of the drains by opening, in places between them, short cuts or pits. Into these pits numbers of travelling worms will fall, to be drowned if the bottom of the pit is of such a nature that the water will lodge in it; but if the bottom is friable the worms will burrow into it and throw up casts. I would here suggest that the worm-casts mentioned by Dr. Darwin ("Vegetable Mould and Earth Worms," pp. 184 *et seq.*) as having been thrown up by worms on the floors of Mr. Farrers's excavations, were made by worms that fell into the excavations, and not by worms that were there previously. Dr. Darwin states that, after Mr. Farrers began to take notes, it was not for five days after the floor had been cleared, and that *after a night of heavy rain* the worm burrows were observed: this is exactly what I would have expected, as, in the previously mentioned pits in the drained fields, rarely will a worm or the track of a worm be found in them until there has been rain, after which their dead bodies or casts are found, due to travelling worms that had dropped into the pit. During the excavation of the carns of Loughcrew, Co. Meath, not a worm was to be seen; but after the floors of the chambers had been opened to the air and rain, innumerable worms flocked in, attracted by the rich soil in the floors.

When making excavations in the large crannog, Lough Rea, Co. Galway, it was found that any cut below the surface of the lake had to be bottomed at once, as otherwise the waters oozed in and flooded it. Therefore the longest cut made was opened as follows:—The first day it was opened the full length about a foot below the surface of the lake, and on our return the second day the water in it was bailed out; after which the trench was bottomed. After the trench was bailed out innumerable worms were found in it. These worms evidently could not come up from below, therefore they must have tumbled into the trench, having come out of the rich surface of the island, in which they were very numerous.

(To be continued.)

IV. EPPING FOREST FROM A NATURALIST'S POINT OF VIEW.

By Frank Fernseed.

EPPING FOREST has, it appears, been formally redeemed from the hands of encroachers, secured against all future interference, and is now thrown open for ever to the people of England. All this having been duly done, I may be permitted to ask what has thus been recovered and secured, and in what condition is it to be preserved for the use and gratification of future generations? These are questions of some importance to the public at large, and it is fitting that they should be answered aright.

There are, I am told, about 6000 acres of land which can never be contaminated by the touch of the building speculator and his familiar imps. But it must be remembered that much of this land—certainly not less than 500 acres, and perhaps much more—has been recovered only in a very imperfect sense. To the north and east of Chingford Station there is a broad belt of country which had at one time been converted into fields. True, the fences and the gates, and all other marks of private ownership, have been removed, and the land is thrown open. But it is a mere barren waste,—treeless, shrubless, flowerless,—painful to walk over, because the ridges and depressions formed on laying it out into fields have not been removed. It is merely a desert over which the visitor has to toil as best he may till he reaches the part still covered with trees. The artist and the lover of the picturesque find here nothing on which to feast their eyes; there is nothing for the naturalist to observe, because there is no shelter for bird, reptile, or insect; lastly, there are no trees beneath which the general public may sit down to rest and meditate. What sort of "restitution" can we call this? If a man steals my dress coat, cuts off the laps, and converts it into a stable-jacket, can he be said, in any fair and just sense of the word, to have made restitution if he gives me back the damaged remains? In this matter justice has not been done. The encroachers should have been compelled to restore the land to its original condition, stocking it with the same trees, bushes, and plants as originally grew there, and to watch over their growth and well-being till thoroughly established. However, as such even-handed proceeding is not to be hoped for,—and indeed the opportunity, if it ever existed, has gone by for ever,—it is next to be asked, What prospect is there of this devastated region being restored to a condition of beauty? I fear, for the present, very little. To plant it would involve a very heavy outlay, which no public body, and certainly no private individual, will volunteer to bear. True, if it could be left untouched for a couple of centuries, trees would doubtless spring up again. The seeds of wild plants would be carried by the winds and by birds from the still unpolluted parts of the forest, and ultimately something like the original vegetation would appear. At the same time I think every observer of Nature will agree with me that if a piece of ground has been "cleared," and is then again left to itself, the new flora which gradually springs up and establishes itself is of a lower type, less beautiful and interesting, than that which has been rooted out. In the present organisation of society man might almost be defined as the cause and the creator of ugliness, and wherever he goes the ugly, in the animal and vegetable world, seems to follow his footsteps.

But even such an inferior flora of docks and nettles and thistles, of groundsel and plantain and dandelions, in lieu of the vanished primrose and cowslip, of wood-anemone and blue-bell, of sweet-briar and woodbine, will not be allowed to spring up. Under present auspices the waste must remain a waste. It is not the visitors to the forest who hinder the restorative process, but the cattle, horses, and even goats, which browse here. Every seedling is safe to be trodden down or bitten off. On the other hand, the grass, being continually eaten short, grows more compact, and its democratic organisation leaves no opening for a richly varied flora to spring up. The cattle occasion another nuisance in the forest, in addition to limiting the number of vegetable species that can flourish. There are, namely, many narrow openings in the dense bushes, forming, as it were, gateways from one sheltered glade to another. Such places are necessarily screened from sun and wind, and if there is the smallest rill or pool the cattle convert the ground into an almost impassable quagmire. Hence it is desirable that the right of pasturage should be extinguished in the forest, as well as that of lopping the trees and digging for gravel. If this can be done, and if the seeds of our native trees, shrubs, and wild flowers were liberally scattered over the ground in favourable weather, it is possible that our great-grandchildren may see these desecrated portions of the forest become once more, in old-fashioned phrase, " fit to be seen."

But independently of the restoration of these parts of the public territory, there is a very important question as to the preservation of the whole. In what state is it to be open for ever for the recreation of Her Majesty's subjects ? As a specimen of free, wild forest,—a portion of England of the olden time, such as it was in the Roman and Saxon days ? Or is it to be converted into something like a modern park, consisting of a stretch of grass, dotted over with trees,—possibly fine ones,—but divested of its thickets and of its multiplicity of vegetation ? Certain omens lead me, as well as others, to fear that the latter view is finding favour with the Conservators. It is ominous that the pools are being drained, that a lake with artificial islands has been formed in one of the low-lying portions of the forest, that its borders are planted with shrubs quite out of keeping with the aboriginal vegetation, and that in certain parts—*e.g.*, not far from the " Woodman," at the top of Sewardstone Green—a rather extensive plot of forest has been stripped of the bushes which grew between the trees. On these subjects certain correspondence has appeared in the " Standard," between a gentleman who signs himself "Lepidopterist" and the Superintendent employed by the Conservators. The reply of the latter, who sneers at "sentimental" considerations, is not very reassuring. He informs the public that the Conservators are acting under the advice of one of the most experienced foresters in the United Kingdom. But what is a forester? Simply a person who understands the culture of trees so as to obtain from a given area of land the greatest amount of saleable timber. Such a man will, of course, be able to give valuable advice as to the management of a park. But it is no part of his studies, no part of his duties, to preserve woodlands in a state of Nature. The brushwood, the climbers, and the herbaceous plants he regards simply as weeds which interfere with the growth of his trees. Now, if the Forest is to be kept in its natural condition, I scarcely see that the advice of such a man can be very much needed. The Conservators ought to consult an experienced botanist, well acquainted with the life-conditions of the British flora, and able to point out the circumstances favourable to the growth of all such plants as could find in the Forest suitable localities.

The Epping Forest and Essex Naturalists' Field Club, who are well aware of what is going on around them, have taken the alarm, and have issued a very able circular pointing out the mischief which must arise if the park scheme is carried out. They show that the woodland pools which are being drained were important nurseries of many species of insects and of microscopic animalcules. If the soil is laid dry a considerable number of vegetable species which haunt swampy ground must perish. If the brushwood and the herbaceous plants disappear a profusion of insects must go, and with them the insectivorous birds. Hence the Forest will cease to afford, as heretofore, opportunities for the quiet study of bird- and insect-life. Scarcely any better arrangement could be devised to secure a rich flora and fauna than what exists ready made to our hands, and which merely wants — letting alone!

I am happy to say that the Council of the Entomological Society have added their signatures to the Memorial drawn up by the Essex Field Club, and I hope that other societies interested in the study of Natural History in its various branches will see the wisdom of doing the same. The Superintendent may, if he think proper, call all this mere "sentiment." But is not the preservation of the Forest altogether a matter of sentiment? It is not a commercial speculation, seeking to extract the greatest amount of profit out of 6000 acres of ground. The object, as I understand, is to afford pleasure and recreation to the greatest number of the people of London.

I will venture to say that not the naturalists alone, to whatever class of society they may belong, but the toiling million of the East-end,—whom it most concerns,—would, if they could be polled on the question, vote almost in a mass for the free, wild forest, in preference to the formal park. It is therefore important that all draining and clearing operations should at once be stopped, and that money should not be spent in spoiling a place of pleasurable resort such as no European capital save Vienna has in its very outskirts.

The value of Epping Forest to the naturalist is the greater because, in addition to its size, it presents regions quite distinct from each other, both in their vegetation and in their insect inhabitants. The low swampy grounds at the Chingford end, and stretching on towards Woodford, differ totally in their productions from the centre of the Forest from High Beech, and yet again from the north-eastern extremity which extends towards Epping. There are certain insects which seem rarely to cross the road leading from Loughton to Epping. *Typhœus vulgaris*, *e.g.*, is the commonest coprophagous beetle on the right hand side of the road, especially on the high grounds above the "Robin Hood." On the left hand side of the road it is replaced by species of *Geotrupes*, especially *G. sylvaticus*. In the region stretching from Sewardstone Green towards High Beech species of *Onthophagus* become much more abundant than in either of the former districts. Whoso wishes to study the habits of the tiger-beetle (*Cicindela campestris*) must go the highest ridge of the forest at the north-eastern end,—a region full of gravel-pits. These are but a few desultory instances of the curious manner in which insect species are parcelled out within very narrow limits, and which can scarcely be studied except in ground which is left in a state of Nature. In this country there is little space which can be exempted from the three great devastating agencies—clearage, drainage, and culture. The more reason, surely, that a spot of land formally and specially reserved for the recreation of the public should be preserved from these modifying causes. There, at least, we may still hope to see the dense thicket a welcome cover for birds, and beneath which the delicate woodland flowers find a temperature often three or four degrees higher than prevails in the open fields; the sheltered glade, fenced round from all the winds of heaven, where the butterflies flit about even on chilly days; and even the occasional swamp and reedy pool, dear to the microscopists. Those persons who are afraid of wetting their feet may turn aside and go elsewhere. But especially to the young such little obstacles are in themselves a treat. To the children whose time is spent alternately in narrow and crowded homes and in the noisy and dusty Board School,—to the older lads and lasses who see little beyond the monotonous evenness of London streets, and the grim formality of the shop and the warehouse,—a plunge through the bushes, a leap over the muddy ditch, a scramble over rough, pathless slopes, have in them a something of the adventurous which adds zest to "St. Lubbock's Day." The Forest, as it is, has scope for thousands of visitors of the most varied tastes. For the sake of the great masses, no less than of the students of Nature, I would say to the Conservators "Let well alone!"

In one point a serious mistake has been committed. It was understood that Mr. A. R. Wallace was a candidate for the Rangership of the Forest. Had this distinguished naturalist been appointed I think I may venture to say that he would have become a resident in the neighbourhood, and that his great knowledge and experience would have been brought to bear in rendering the Forest a preserve or shelter for the British flora and fauna. The Duke of Connaught has neither the special knowledge of Mr. Wallace, nor does he, as far as the public have ever learned, take any deep interest in animal and vegetable life. If he did, his other pursuits and the duties of his station would effectually prevent him from being other than a mere titular Ranger.

V. THE EXPLORATION OF PALESTINE.*

TEN years ago, the trigonometrical Survey of Palestine was commenced; it is now, as to the west, an accomplished fact. Five years ago, 4700 square miles had been surveyed, and within two years more the remaining

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* I. The Great Map of Palestine.

II. The Map, in six sheets, to accompany Saunders's Introduction, Exploration Society, 1881-2.

III. An Introduction to the Survey of Western Palestine, by TRELAWNEY SAUNDERS. London: Bentley and Son, 1882.

1300 miles. The work is now crowned by the Map, measuring, as a whole, on the scale of one inch to the mile, 13 feet by 7 feet; and by the accompanying "Memoirs," with index, illustrations, plans, photographs, the native names with their signification, and the like; not yet finished, but probably reaching to ten volumes. We may add, the work has been also further completed by Mr. Saunders's "Introduction," a specialty as to waterways, plains, and highlands; the Geography of the Survey; the key to its Great Map, each essential to the other and its complement. Moreover for this "Introduction," a Special Map has been prepared, adapted to its special scientific subjects, the hydrography and the orography of the country surveyed·

Of necessity, a book of this kind, on such a subject, for such a purpose, presupposes in the reader, or rather in those who put the "Introduction" to its intended use, some previous knowledge of the bearing and incidence of the different points of physical geography it advances or establishes. Of necessity, too, it has nothing, or very little, of a popular character, though Mr. Saunders has steered clear of being too severely scientific. He has divided his subject into four parts; the natural division indicated by the country surveyed. I. The Mediterranean Watershed, with its fifteen basins, their outfalls and water-partings; taking in also the district of Mount Carmel. II. The Western Watershed of the Jordan and the Dead Sea Basin, with their numerous other basins and water-partings. Part III. treats of the plains of Western Palestine, *i.e.*, the plains on the Mediterranean slope, the plains of Galilee, the maritime plains to the south of Carmel; also the plains, lowlands, and lakes of the Jordan slope, including the Galilean Gorge, the west shore of the Sea of Galilee, the Plain of Jericho, and the like. Concluding, Part IV., with the highlands, the mountains of Upper and Lower Galilee, and the highlands of Samaria and Judæa.

It will be seen by a glance at the Map, how much all this covers, and how much the Map and this Introduction owe to each other. Both are the result of an original survey of the ground as a whole on the best scientific methods, made on actual observation, giving all the results usually desired in a topographical may. Mr. Saunders brings to his part of the work one special qualification; he had formerly laboured with Dr. Grove, before the Palestine Exploration Fund Survey, to construct a map of the Holy Land from materials then in existence; and anyone contrasting the present Map with its predecessors will at once perceive the immense accession of details of which this book, with its capital index and table of contents, is evidence. This is the more remarkable as the physical geography of Palestine, though an object of the Exploration Society and a most valuable one, became for a time almost subordinate to the interest of the excavations in and around Jerusalem.

Not only the whole "lie" of the country and its contours, the rivers and river systems, the water discharge, the watersheds, and the drainage are placed before us complete as to the hydrography of the country, but it is also, as an orographical map, absolutely complete when supplemented by the seventy-five pages of Mr. Saunders's Part, IV., which show the relations of the streams and plains with the highlands.

Admirable as is this work, we must, however, express almost disappointment that as an "Introduction to the Survey" it omits altogether any reference to those geological causes which we venture to think would throw light on this special subject and add to its interest, as well as thus give a key to the existing formations. We will instance what we mean by a glance at the Map around Galilee. The whole of Galilee presents a country more or less disturbed by volcanic action. The whole drainage is collected by the Kishon. In the lower division, the hills are all tilted up towards the east, and broad streams of lava have flowed over the plateau above the Sea of Galilee. The inference is irresistible.

Again, remembering the salt springs which flow to the Jordan along the greater part of its course south of Beisán, and the raised beaches which have been found in various parts of the Ghór, the valley formed by a depression in the early Tertiary period was once, we cannot doubt, filled by a chain of lakes, and this, geologically, accounts for it. And yet again, considering the part which the Mediterranean Watershed occupies in Mr. Saunders's book, scientific as his arrangement rightly is, we cannot but think it would properly have admitted a geological reference to those far-off days when, as its fossils yet testify, the Mediterranean itself was a continuation of the Indian Ocean. This curious absence of geological remarks, if it does not impair the value of what is recorded, seems to leave in it almost a gap; at all events, we wish Mr. Saunders had condescended to suggest something of the kind, for the sake of the interest it imparts and the facts it establishes. We the more readily make this suggestion, as Mr. Saunders himself, lamenting the limits of his present work, adds that further investigations will follow.

Of the Great Map of Palestine (I.), it is impossible here to speak adequately. It shows the towns, villages, ruins, roads, watercourses, and buildings; tombs, caves, cisterns, wells, springs, and rock-cut olive and wine-presses. Not only are the hills delineated, but their cultivation noted; olives, figs, vines, palms distinguished; the wild growth, oak-trees, scrub, and the principal separate trees, appear; the Roman mile-stones on the roads are marked, and the many relics of antiquity; the heights of the principal features of the country are given; and the levels of the Sea of Galilee and of the Dead Sea have been fixed to within a foot.

Nor is this all, for a special edition (II.) has been prepared, reduced from the one inch map to ⅜ths of an inch to the mile, illustrating the natural drainage and its divisions, and also the mountain ranges, according to the "Introduction" of Mr. Saunders. The river basins are marked and coloured, with their water-partings, and the main water-parting of the Mediterranean and Jordan watersheds. Even the minor basins,—those not extending to the main water-parting—and the small inland basins, also appear and are tinted.

Vertical sections exhibit the natural profiles of the country, according to the variations of altitude above or below the level of the sea. The ranges, the mountains, and hills are shown in colour; their heights projected on the meridional section, according to latitude, on the others according to longitude; perennial streams distinguished from dry watercourses, roads from tracks; nor is it without significance that we see the old Roman mile-stones side by side with the electric telegraph and the trigonometrical stations.

Thus has Palestine, so far as its western portion, been brought home to England by the Exploration Society, which has also now begun the same delineation eastward of the Jordan. Of the commencement of that further Eastern survey and exploration now in progress, we may hereafter give some account.

We dismiss this valuable Map—in affluence of detail, and care for accuracy and identification, comparable only to a German military map—and this admirable "Introduction," with one remark as a corollary to what we have said. The Exploration Society have done for Palestine what is yet wanting for England, where only of late are its rivers coloured blue on our Ordnance maps. We have increasing need to know the river-systems and the watersheds of our own country. Good as are now our coloured maps, they are deficient in this; and with our growing wants for drainage and for the prevention of floods from rivers, that deficiency is a practical evil. We will instance what we have in mind. The French inundations of 1875 will be long remembered, when almost the whole of Languedoc was under water, and Toulouse was nearly destroyed. Now we know that in prehistoric times this overflow of the Garonne was prevented or greatly lessened by lakes now filled up, and that at the present day the floods are thus vastly more violent and destructive than formerly. The practical lesson is obvious.

The foundation of a geographical map is its outline, and that consists chiefly in the delineation of its waterways; a distinct acquaintance with this branch of the subject is a fundamental element of geographical knowledge. As Mr. Saunders says in his Introduction, "in tracing a watercourse from its source to its final outfall, it is found that some outfalls dispose of the waters of small areas with simple systems of watercourses; others are the drains of large areas with a great complication of watercourses not easily unravelled." It is just in this systematic examination that the Palestine Survey and its Map are so admirable, and that our Ordnance Surveys and the best contoured maps are so defective; a serious hindrance, and an impediment, at every Sanitary Board in the kingdom, when attempting the drainage of its district; for a "water-parting," be it remembered, may be as much a simple ridge, or a mere swelling of the ground between two of the smallest streams, as the natural division of the waters of a hemisphere; one of the lessons practically taught by the Map of Palestine and its "Introduction."

VI. NOTES OF EXPERIMENTS ON THE ACTION OF COLOURED LIGHT ON CARP.

By A. Anthony Nesbit, F.C.S.

It is well known that fish alter in shade when the colour of the bottom of the water in which they live is altered, becoming darker when the bottom is darker, and lighter when the bottom is lighter. For the purpose of ascertaining whether this alteration is due only to the quantity of light—

that is, to light and shade—or whether actinic rays and the colour of the light have also an influence in producing the change, the following experiments were conducted. If they indicate nothing else, they certainly show that:—Firstly, colour is a factor in the change, as the blue produced darker fish than the black, and red had no action whatever. Secondly, that blue, the colour of the sky, and not black or green, the colour of mud and foliage, is the best and most healthy colour for carp.

FIRST SERIES.

The globes intended for the reception of the carp were covered *externally* with a varnish coloured with aniline dyes. The dyes used were alkaline blue for the blue, eosine for the red, tropæoline for the yellow, and a mixture of aniline dye producing a grass green for the green. The black globes were varnished *externally* with Brunswick black, while in every case the tops were covered with large concave covers similarly coloured to the globes, air being freely admitted by the intervention of corks between the globe and cover. The carp used were the Prussian carp, *Cyprinus gibelio.*

Red.

Jan. 14*th.*—Three normally coloured carp were put into three separate globes coloured with eosine. The fish were healthy.

Jan. 21*st.*—All in good health and would feed.

Feb. 10*th.*—The three fish were removed from their globes into an uncoloured one, and on comparison with carp which had been kept in uncoloured globes for the same length of time were pronounced by four persons, making independent observations, to be unchanged in colour. They were then replaced in the red globes.

Yellow Light.

Jan. 14*th.*—Three normally coloured carp were put into three separate globes coloured with tropæoline. The fish were healthy.

Jan. 21*st.*—The fish were healthy, but paler.

Feb. 10*th.*—The fish were considered, by four persons making independent observations, to be much paler than the normally coloured.

Blue Light.

Jan. 14*th.*—Three normally coloured fish were placed in three separate globes.

Feb. 10th.—They were considered by four persons, making independent observations, to be darker than the normally coloured fish.

The carp in the blue globes became of a beautiful purplish velvety darkness, deepest on the back: their fins changed to bright red, and their whole appearance became vigorous and handsome in the extreme.

In the red and yellow globes the fins of the carp continued much the same shade of colour as their bodies, while the whole appearance of the fish was less vigorous than that of those kept in the blue globes.

Unfortunately, these fishes were attacked by a parasitic growth, and it was then observed that those carp which dwelt in the blue globes made by far the strongest resistance to the attack of disease, and did not succumb until the parasite had attained double or treble the size which caused death in the other carp.

SECOND SERIES.

Commenced April 7th, 1882.—Experiments were started on red, yellow, blue, green, and black, and also a standard of comparison in clear white glass.

Three experiments for each colour in three separate globes.

On the 14th of April they were examined, when a great change had taken place. The blue were found to be by far the darkest, to have bright red fins, and looked the most healthy. Next to the blue the black came in darkness of tint, and with fins slightly tinged with red, but were not so healthy looking. The fish in the green glass globe came next in order of darkness, while those in the red glass remained unchanged; but the fish in the yellow glass were much lighter than the standard of comparison.

The green were by far the most languid and unhealthy.

On the 21st all these fish were again observed, with the same result as on the 14th.

It will be seen that the second series of experiments fully bears out the first in demonstrating that colour is an essential factor in the health and appearance of fish.

These experiments are being prosecuted further.

ANALYSES OF BOOKS.

Dyeing and Tissue Printing. By W. CROOKES, F.R.S. (*Technological Handbooks*. Edited by H. TRUEMAN WOOD, Secretary of the Society of Arts.) London: George Bell and Sons.

THE Council of the City and Guilds Institute have felt it necessary to prepare a series of manuals specially designed for the use of students preparing for the Technological Examinations. Such works it was felt, whilst embodying the leading principles of the arts and manufactures in question, should not be too voluminous, and should above all admit of being offered at a reasonable price, so as to come within the reach of students of the working classes. Of this series the treatise before us is, we believe, the first to appear. It is a compact and closely printed volume of some 400 pages, and in conformity with the conditions laid down it contains neither illustrations of the plant and machinery used, nor patterns of dyed and printed goods. Such features, though admittedly useful, would have seriously raised the cost of the book.

The author announces that his object has been more to exhibit the general principles of the arts of dyeing and printing in their practical working than to enter into all their interminable *minutiæ*. For the latter purpose, indeed, a library rather than a manual would be needed.

As far as possible, however, within the space at disposal an attempt has been made to give the main features of the different kinds of dyeing and styles of printing. Very various methods as used in different establishments and different countries have been given. The use of the coal-tar colours which, as the author remarks, have at once "extended, simplified, and rationalised the tinctorial arts," has been shown in a number of well-selected examples.

It has been no part of the object of the work to give instructions in general chemistry. Such information, however useful or rather necessary, the students of the Institute can obtain from some of the many good and cheap manuals of chemistry which appeared of late years, and of which it would be almost invidious to name one in preference to others.

As a matter of course no book—as indeed is here fully admitted—can of itself make any man a dyer or a printer. For this purpose practical experience is necessary. But there is experience and experience. There are men who have worked for many years in dye-works and who can produce a certain round of colours more or less successfully. But they make no improvements; they never see the way to a saving of time, labour, or materials, or to obtaining a better result. In any unusual case, such as dealing with any novel materials, they are lost. The practice and experience, therefore, must be observant and judicious if they are to lead to a true mastery of the art. It is becoming in these days more and more necessary for every artizan, especially in what may be called the more scientific branches of manufactures, to understand what are the principles of his work; to know why he does this and omits that, and what are the properties of the various agents which he has to employ. We hold that one of the greatest misfortunes which can happen to a nation is to have unobservant working men. The main object of the City and Guilds of London Institute is to assist in freeing the United Kingdom from this danger.

The work before us possesses several features which must certainly commend it to the common sense of all persons capable of judging. The language of strictly scientific circles has not been indulged in, preference being given to the briefer technical terms used in dye, print, and colour works, such terms having been, as far as we see explained, for the benefit of the learner.

After a section devoted to the principles of bleaching, Mr. Crookes treats at some length on the kinds of water to be selected for dyeing and printing, on which subject he gives very useful and practical directions. He then passes to a consideration of mordants, including those of a metallic character, the tannins, the oily bodies, and the albumenoids, This chapter is, indeed, most carefully and admirably written.

A succeeding section giving general instructions on dyeing, bears also the stamp of practical thoroughness. Great emphasis is laid upon purity and cleanliness as regards the water, the vessels, the colours to be used, and the materials to be dyed. The cautions given as to matching off and the statement of what is really expected from the dyer are thoroughly sound and judicious.

In speaking of tissue printing, Mr. Crookes calls attention to the importance of a scientific juxta-position of colours in the work produced. Neglect or want of skill in this department has, especially in former years, made English printed goods appear at a disadvantage as compared, *e.g.*, with the products of Alsace. He remarks : "Colours, in themselves excellent, may be made to look dull, flat, and ordinary, if grouped together in disregard of optical laws. On the other hand, shades which, taken singly, possess little merit, may by judicious arrangement raise and relieve each other so as to produce a very fine general effect. Hence tissue printing stands on the very boundary line between manufactures and the fine arts, and requires the co-operation of the colour-chemist, the mechanician, and the artist. Indeed the ideal manager of a print-works should combine in himself the knowledge and the resources of all the three."

These are heavy demands, but if this great branch of our national industry is to hold its own they must be fulfilled. We believe this little work will be found very widely useful, and we hope that the remainder of the treatises to appear under the auspices of the City and Guilds Institute will be conceived and executed in the same rational and practical spirit.

Private Instructions in the Science and Art of Organic Magnetism. By Miss Chandos Leigh Hunt. Third Edition. London: Burns, Southampton Row.

Books such as the one before us are, in more respects than one, not unlike the first journals of exploration in an unknown region. On the one hand, they rouse the curiosity even of the calmest and most judicially-disposed reader. On the other hand, they suggest the doubt, how much of what is recorded is the fruit of pure strict observation, how much is mere inference, drawn possibly from insufficient premises, and how much, possibly, is illusion? The orthodox mode of treatment for works of this class is simple and convenient: they are dismissed as the outcome of ill-regulated minds, under the influence of "dominant ideas." We can scarcely accept this method as legitimate. Illusions, even, are psychic phenomena, and it hence falls strictly within the province of Science to examine their nature, and, if possible, to explain their origin. Moreover, if only a small portion of what is stated in this volume should be true,—that is, should be a literal record of facts and a body of fairly-drawn conclusions—the subject is, both theoretically and practically, of the gravest importance.

Miss Hunt defines, or rather describes, "organic magnetism" as "an emanation arising from organisms." She calls it "organic, to distinguish it from an analogous emanation which surrounds inorganic things. This emanation can aptly be compared to a Spirit-vapour—in its most passive state it has a tendency to ascend in the atmosphere." She adds: "Its peculiar characteristics are derived from the nature of the thing from which it emanates. Some people intuitively know the character of a man, animal, or plant by sensing this emanation, upon which they found their sympathies or antipathies for its generator; they intuitively feel that a man is good or bad, an animal kindly or vicious, a plant salutary or poisonous."

Several questions here suggest themselves to the reader. Is there any "emanation" arising from organisms as a class, and to be distinguished from some other emanation which proceeds from inorganic matter? We know, of course, that many kinds of mineral matter are more or less volatile. It is found that certain bodies commonly pronounced non-volatile have an odour,—such as caustic potash and soda. It has lately been proved that certain metals, such as lead, iron, gold, and copper, if placed near to, though not touching, plates of other metals, exert an influence upon them, which for a time alters their electric relations ("Comptes Rendus," xciv., p. 1247). But these emanations are simply minute particles of themselves.

Living organisms are the seat of more complex phenomena. In their case we are naturally reminded of the speculations of Prof. Jäger ("Journal of Science," 1880, p. 298), which, though exceedingly suggestive, and though put forward by a naturalist of good standing, lack satisfactory verification. Everyone is of course aware that animals are constantly throwing off the products of respiration and volatile matter, given off in the form of insensible perspiration. But as for any other emanation we must consider its existence, for the present, not proven. We commend the matter, however, to the attention of our readers, and any thoroughly authenticated instances will receive careful notice.

But supposing such an emanation to exist, What is its nature? Is it a form of energy, of the same order as heat, light, magnetism, or electricity, and capable of reciprocal transformation with any of these agencies? Is it a form of matter? Or is it neither matter nor energy, but in its essence spiritual? To none of these questions can a definite answer be extracted from the work before us. The words "a Spirit vapour" convey no definite meaning. The alleged tendency of this emanation to ascend in the atmosphere would seem to point to a material character. But the introduction of "will"—which, indeed, plays a prominent part throughout the work—greatly complicates the question. That either a material emanation, or a mode of energy thrown off from the body, can be made "to travel in any direction" and to an unknown distance, by an act of "will," is perfectly unthinkable, and on this point further light is urgently needed. We may mention that Dr. Kieser (not Keiser), some of whose writings Miss Hunt quotes, gave to the mesmeric or organo-magnetic emanation the name "tellurism," and regarded it as a form of energy emitted by the earth or any other planet, and opposed to the light of the sun. His treatment of the subject, when freed from the strange conceptions of the "Physiophilosophic" School, once very powerful in Germany, may perhaps pave the way to the reduction of any demonstrable phenomena belonging to "organic magnetism" under scientific laws.

There are, we learn, three kinds of magic, two of them good, and one of them evil. Of the two former, the *white* is the lower, and the *red* the higher grade. The evil, or *black*, magic is an application of the same kind of power to selfish and immoral purposes. Organic magnetism is a part, but a part only, of each of these kinds of magic. To become a red magician "fish, flesh, fowl, alcohol, drugs, tobacco, mineral substances, and every such perversion of the natural appetite must be religiously abstained from, and your tastes therefore re-directed into their proper channels." Again, "every poisonous vegetable and every mineral drug must be strictly avoided." Without raising the question how the "natural appetite" has been ascertained, we may here ask for the definition of the terms "drugs" and "poisonous." Most fruits, leaves, &c., contain principles which may be fairly called "drugs," and which in sufficient doses are distinctly poisonous. We read on p. 7: "If you have taken many drugs, much alcohol, or tobacco, let pure and strong coffee, without chicory, enter largely into your diet as an antidote." Whilst warmly applauding the proviso "without chicory," we must not forget that caffeine, the essential alkaloid of coffee, is a drug, and in large doses a poison. Further, alcohol is not confined to fermented and distilled beverages artificially produced by man. It is now known to be a natural product, met with in small quantities in various fluids and solids. Without entering into the vegetarian controversy, we must call attention to the following passage (p. 5): "To become a Red Magician you must strictly follow Christ's laws, and imitate His life both in the letter and in the spirit." How this imitation is made to agree with the injunction to abstain from animal food we do not see.

The authoress protests against Mr. Braid's theory, and insists that "hypnotism proper and magnetism proper are not identical." The former, she considers, an exceedingly dangerous process, as may be concluded from Mr. Braid's own statement, the pulse in a subject operated upon rose to 180 beats per minute. We do not know what Miss Hunt thinks of Prof. Harting's recent cautions as to the dangers of "mesmeric" experiments to the subject operated upon. But after carefully reading Chapter IV. of the work before us, "How to become a public and private demonstrator of magnetic somnambulism," we feel strong doubts whether such demonstrations performed upon human subjects are legitimate. The experiments of Baron Dupotet, described on pp. 178 and 179, if realities, are simply horrible. Still worse are the cases given on pp. 187 and 188. To do the authoress justice, she gives very plain warnings against allowing a subject to become frightened whilst in the magnetic trance. We should, however, think that all experiments, in order to ascertain the reality, the conditions, and the laws of the imperfectly known agent in question, should be made upon the lower animals. For this purpose Miss Hunt gives very full directions. We quote the following strange passage: "The deadly effect of human saliva on poisonous snakes is positively asserted by a Georgia farmer. According to the "New York Herald," as the farmer was in a field picking up some straw, a rattlesnake, 4 feet long, fell from the straw at his feet. He set his heel on the reptile's head and spat into its mouth. In a few minutes the snake became sick and powerless, and died in a quarter of an hour. Shortly after he caught an adder, and on following out his experiment the creature died; whilst by merely wetting a stick with his lips and drawing it across another adder's nose, the same result ensued. On spitting into the mouth of a harmless snake, however, the creature was uninjured." The poisonous character of the human saliva has been, indeed, rendered highly probable by recent investigations, but the Georgian story just quoted bears a somewhat apocryphal character. The rattlesnake might die from the bruise on its head. Or the farmer might have been chewing tobacco, the active principle of which is very rapidly fatal to serpents. It might be interesting to try the experiment upon the common viper. Only let no one make the trial in England, or he will be liable to the penalties of that national stigma, the Vivisection Act!

We rise from the study of Miss Hunt's work with the conviction that there are certain phenomena not yet formally recognised, much less explained, which require, and would doubtless repay, the prolonged and earnest study of thoroughly scientific minds. Unfortunately, in England, and we believe also in France, they have been dealt with chiefly by minds of an avowed anti-scientific tendency. The work before us will doubtless draw increased attention to this difficult subject.

"*Two Planets beyond Neptune*," 1875, and "*On some Properties of the Earth*," 1880, by O. REICHENBACH. London: Wertheimer and Lea (pub. pri.). As reviewed in a letter of Professor Klinkerfues, Director of the Gœttingen Observatory, to Mr. Warnstorff, Bookseller at Northeim.*

"THE first research which engaged my attention in the book of Count Oscar von Reichenbach, was a comparison of the whole mass of sun and planets with that gaseous mass out of which sun and planets have been formed by cooling and contracting, according to the Kant-Laplace theory.

"Under a certain hypothesis, about the original distribution of mass and density of strata in the gas-like nebula, the author arrives at the result that, compared to the latter, there still remains some mass for one or two large planets. If various things may be said against the hypothesis, Gauss, for instance, had, notwithstanding his veneration for Kant and Laplace, the objection that Uranus is considerably more dense than Saturn, and that this is scarcely compatible with the hypothesis; spectral analysis, however, now forcibly pleads, by its results, for such a genesis of the planetary system, and it will be therefore admitted at present on the whole and in a general way. Yet the Gaussian objection is precisely, for the case in question, of great importance. For, even in meteorology, the physicist finds it an almost entirely unsolvable task to determine by calculation the density of the strata of the terrestrial atmosphere, with its height of only about 16 geographical miles, under the influence of the changes of temperature and the consequent motions. This difficulty must be increased to an enormous degree in the case of a gas-sphere some thousands of millions of miles in diameter cooling down from glow heat. In spite of all this and that, it must be admitted that the inquiry has been carried through with perspicacity and ingenuity.

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* Besides the pamphlet and book reviewed, Professor Klinkerfues had in hand "Gedanken," 1857, and two articles in vol. iii. (3rd series) of the "Journal of Science," 1881, London, by O. Reichenbach, partly referring to the same subjects.

"Even an antagonist of metaphysical reasoning and partisan of the inductive method may befriend himself with it on account of its euristic value. One here thinks quite spontaneously of the so-called Borde-Titius series, which became the occasion to look for a planet between Mars and Jupiter. Notwithstanding the series cannot be proved, and the result has been another and an unexpected one, it may yet not be denied that it has been useful to science. But one may also quote an example, how metaphysics may mislead on this ground. A short time after Hegel had proved in his inaugural address that there could not exist any more planets than were known at the time, a new planet was discovered, we might think as a warning for all metaphysicians and all times.

"It is not at all rare that the author of a book is proudest of what an unprepossessed criticism cannot approve. This applies (*or seems to me to apply*) to that part of the book in question, which tries to prove that the surface of the earth, also the distribution of water and land, must be exactly so constituted as it is known to be. The critic, however, can here only judge that the *à priori* proof contains more than one dark passage, and that there also exists no proposition whatever for such a demonstration. Its discovery would furnish the subject for a prize theme. *Yet a directly denying criticism I would not like to exercise,* because I am not sufficiently at home on this ground, which the author appears to be, *at least, as far as regards the material.*—Gœttingen, February 11, 1882."

Appreciating the advantage that an eminent *savant* has expressed an opinion on my work, aware that theories now famous have fared much worse, and thankfully acknowledging the regardful, antithetical, and cautious character of Prof. Klinkerfues's criticism, I point out in the interest of my views some erroneous statements and superficial readings.

It was the pamphlet which engaged the attention of the criti by its " euristic value." Like most modern scientists, great and small, he has his fling at metaphysics. " Partisans of induction," yet unable to define and respect the boundaries with metaphysics, always over their ears in mystics, ethers ponderable and imponderable, God knows, one boxed into the other, lastly all preserved in a frictionless liquid—whatsoever that may mean—space of four and *n* dimensions, geometrically an absurdity, metaphysically a lie, and intellectually a humbug, and deeply oracular in phrases, survival of the fittest and natural selection to wit, these gentlemen blaspheme and deny their metaphysicism, be it of the revealed or of the intuitive type, as Peter did his Christ, for the occasion.

I have sometimes committed the sin of metaphysics; they are the infinite sea from which all finite science rises, and on which it must for ever float; without them we would be savages worse than brutes. If the pamphlet moves on the boundary of metaphysics and physics until the planets are seen, the book begins within the domain of physics and mechanics. Pamphlet and book contain hypotheses approved by facts, theoretical constructions and mechanical explanations of the visible, measurable, and ascertainable, according to admitted laws; they establish probabilities on deductive and inductive bases.

If the critic had read the pamphlet thoroughly, and had looked over those pages in " Gedanken " to which it refers, he would have seen that I adopt from the Kant-Laplace theory the visible nebula, without defining it as a gas at glow-heat, but that my hypothesis of the development of our solar system differs largely from that of Laplace, that it tells why Saturn is less dense than Uranus, and has room for rings and for meteors big as comets and small as the atom which was the embryo of our sun in the parental nebula. He would have seen that I wrote of the Bode-Titius series, " it is an accord falsely taken in what there is, without theoretical foundation, but it attracts our attention." He would have seen that I do not arrive at the conclusion that there still remains mass for one or two large planets, but that I speak of two and give their elements and positions with an approximation which, as predictions with a metaphysical touch, may turn out more correct than did the mathematically-accomplished deductive predictions of Adams, and even of Leverrier.

The book does not begin with an " *à priori* proof," but with an *à priori* statement of facts sufficiently striking and curious to set thinking " unprepossessed " minds thinking, but unnoticed before my time. Having thus advertised my work, as the showman the wonders in his booth, to professors, learned societies, and the " infima plebs," I explain how such facts originated, and prove how they got developed, giving a proposition and a demonstration. Discovery of such a proposition can be therefore not the " subject of a prize theme," the problem having been already solved, which does not exclude that the demonstration may be mathematically improved and spun out and occasionally marred.

I do not show "that the surface of the earth, also the distribution of sea and land, must be exactly so constituted as it is known to be," but I show why, being constituted as we know it, the regularity and organisation existing in that constitution have remained *unknown*, and how, under the operation of mechanical laws, this organisation has progressed in harmony with the development and organisation of the solar system. I point out that, starting from logical metaphysics about matter, that is gravity, and void, that is no matter, older than this book, I traced by deduction from known facts, and by application of mechanical laws, that is by induction, that certain facts should exist in connection with our earth, and then only looked for them and found that they do exist, and thus discovered that the known earth is still in many respects unknown for those who hear and see only what suits their big or small selves.

I therefore congratulate Professor Klinkerfues, who knows much more about the materials cast by me in one comprehensive mould than I "appear to know" about them, on the caution that "yet" he "would not like to exercise a directly denying criticism."

O. R.

Spon's Encyclopædia of the Industrial Arts, Manufactures, and Commercial Products. (Division V.) Edited by C. G. W. Lock, F.L.S. London and New York: E. and F. N. Spon.

The volume before us completes Messrs. Spon's great work, and we are happy to say that it shows no falling off in care taken in compilation and in the general accuracy and value of the subject matter. The test question for any work of reference like the present is simply—does it contain useful information not readily to be met with elsewhere? And to this we must return a most decided affirmative. It might often require a search of some hours in the library of the British Museum to find some desired fact which is here recorded.

Under the heading "Pigments and Paint," we find a true but somewhat humiliating reflection:—"We have only to compare a Van Eyck with a painting by a modern master—Turner for instance—to see that even the best of recent painters have not succeeded in giving to their works that durability which the originators of the method (oil painting) attained." This fact, for such it is, is a poor compliment to chemical science, and is a proof that the notion of lost arts is not something to be laughed at. Whilst making improvement in certain directions, we have been losing ground in others.

Passing over the long and elaborate articles on pottery and on painting, we come to a treatise on resinous and gummy articles, extending to no fewer than seventy-five pages. It may, of course, be objected that there are thus included under one head products differing essentially in their chemical relations. The characters of these two groups are, however, given in detail at the outset, so that practically no inconvenience can arise. There are a few remarks on the origin of gums which were formerly supposed to be secretions. Recent investigations have proved that they are formed from the whole tissue of the cell-walls. It may, by the way, be suggested that gum is a morbid product. The writer admits that gums are yielded most abundantly when plants are in a sickly state.

Under gum arabic we find mention of a gum furnished by several Australian species of Mimosa. The trees are much more rapid in their growth than the cognate species in Africa, and there is reason to believe that the Australian gum might become the subject of a large trade, especially as its mucilage when dry is less liable to crack than that of some other kinds.

Balata, a gum-resin of the caoutchouc class, though in considerable demand, appears less and less in the market owing to the difficulty of procuring a regular supply. In America it is put to the singular purpose of a chewing material.

Under dextrine we find mention of the fact that experiments to produce dextrine from cellulose have proved failures. The attempt, however, should not be abandoned, as the value of cellulose is very much lower than that of starch, the present starting-point of the raw material. We do not see any reference to the most important impurity, sand or grit.

It is a somewhat remarkable fact that the various resins used in compounding incense seem all to contain more or less benzoic acid. It is hence possible that their original use was as disinfectants.

Concerning gutta-percha there is much interesting information. It appears that unless the tree is cultivated and a method is brought into use of collecting its milky juice without killing it, the supply must soon be at an end. The article is adulterated on the spot by the collectors. In Borneo about 20 per cent. of scraped bark is added, to which its reddish colour is due. It is even said that the Chinese middle-men who buy it from the gatherers, refuse to take it in its pure condition. Gutta-percha appears to undergo no change by twenty years exposure to sea-water, though if alternately wetted and dried, it rapidly deteriorates, a fact which has almost put an end to its use for jugs, syphons, funnels, carboys, &c.

Caoutchouc is exposed to the same peril as gutta-percha, the demand is rapidly extending, the wild supply is as rapidly decreasing, and attempts at its cultivation, though not altogether wanting, are scarcely made on the scale and with the vigour that are required.

A similar complaint must be made concerning the gum-kauri of New Zealand, as the trees are being extirpated. It is estimated that half a century will see their practical extinction, and the local government, with true English disregard of the future, takes no steps for their protection or propagation.

The article on silk is very important. It is unsatisfactory to find that India only produces one million pounds, as against six and a quarter millions from Italy and eight millions from China. Much may be hoped from the efforts made in Australia, but amidst many advantages there is in that group of colonies one important obstacle—the drying winds from the interior. In America the silk culture will meet with an impediment in the "norther" from which, probably, no part to the east of the Rocky Mountains is quite free.

In the treatise on soap it is much to be regretted that the strengths of solutions should have been expressed in Baumé's scale, which can scarcely be said to have a point in its favour.

Notwithstanding some few defects, scarcely to be avoided in a work dealing with such a range of subjects, Messers. Spon's Encyclopædia will not for a long time be superseded. The trade statistics introduced under almost every section, showing the extent of the exports or imports, and the average London prices, will be a great convenience to the commercial world. The manufacturing articles give an excellent idea of the processes now in operation, and readers of an inventive turn will often find their attention called to some desideratum offering a good scope for their ingenuity. We can only express a confident hope that the work will be highly and duly appreciated by the public.

British Fresh-Water Algæ, exclusive of the Desmidiæ and Diatomaceæ. With coloured plates by M. C. Cooke, M.A., LL.D., A.L.S. Part I. Palmellaceæ, pp. 28, 11 plates. Part II. Protococcaceæ and Volvocineæ, pp. 45, 16 plates. London: Williams and Norgate. 1882.

The best text-book on this subject, "Hassall's Fresh-Water Algæ," published in 1845, is now extremely scarce, and much of the information therein contained quite out of date, owing to the numerous discoveries made during a period of more than thirty-five years, most of which are scattered through the pages of numerous scientific periodicals. Under these circumstances, the issue of a new work on the subject cannot but prove acceptable to an increasingly large class of readers, who, thanks to the Royal Microscopical and other kindred societies, of which it is the parent, have been taught to study natural science for its own sake and to take a deep interest in those lower forms of animal and vegetable life, of which the present work deals with some of the most interesting and important.

The author has very wisely adopted the form of publication in monographs, two of which are at present issued. For a work of so great an extent as the one now to be considered, this system has many advantages; the portions issued are complete in themselves, and the delay unavoidable where many authorities have to be consulted and numerous specimens examined, figured, and not unfrequently searched for, rendered of far less consequence than it would be in a work announced for issue at regular intervals.

The plates are especially good, and in many instances are from the author's own drawings, in which case the dimensions, as they invariably should, accompany each figure.

The life-history of some of these low forms of vegetable life is extremely interesting. The well-known *Volvox globator*, had its various stages not been traced out, would appear to be at least four or five distinct organisms, and has in earlier works been so described and figured. The subject is a very suggestive one, and promises much interesting work for the microscopist in carefully watching other forms through the whole term of their existence.

It is to be hoped that the author may be able to spare a few pages for an introduction to the study of the Fresh-Water Algæ, and also for a glossary. This will be especially welcome to those of Dr. Cooke's readers who, although ardent students of nature and skilful workers with the microscope, are in many instances but little acquainted with Greek and Latin, and will be much troubled with a terminology rendered necessary by recent advances in science, but nevertheless difficult to understand without some assistance.

The work, as far as published, bears evidence of painstaking research, althought it must of necessity be in great part a compilation of the scattered records of other observers.

Anecdota Oxoniensia, Texts, Documents, and Extracts. Chiefly from Manuscripts in the Bodleian and other Oxford Libraries. Mediæval and Modern Series. Vol I., Part. I. Sinonoma Bartholomei. Edited by J. L. G. MOWAT, M.A. Oxford: Caledonian Press. London: H. Froude.

WE have here a very curious glossary of botanical and medical terms as used in the fourteenth century. It forms part of a treatise on diseases and remedies written by John Mirfield or Marfield, and bearing the title "Breviarium Bartholomei," from the monastery of St. Bartholomew's in London. The language is a curious mixture of Mediæval Latin, Arabic, and old English. In many cases the names assigned to plants and drugs would be quite unintelligible without the appended explanation. In the author's time, it appears that alcohol or alcofol signified a powder for the eyes; "abarath" stood for white lead, and "almahar" for litharge. As instances how the names of plants have changed, we may mention Ligustrum, which then signified the wildwhite convolvulus, though others used the same word for "hunnisuccles," and even for the "primerose" and "cowyslepe." Oleander was then the wild olive-tree, Gladiolus was the sweet flag or acorus. The question may be raised why the cyclamen was called by our forefathers swine's-bread, *panis porcinus*, or herthenote. The root is decidedly poisonous to man, and would probably not agree with pigs. Being mentioned more than once in this glossary under different names, it seems to have been regarded as of considerable medical importance. There is the remark appended, "nascitur in locis ubi crescunt castaneæ," referring, of course, to the sweet chestnut. The doctrine of four cardinal properties in medicinal agents, *i.e.*, heat, cold, moisture, and dryness, upon the mutual action of which their efficacy was supposed to depend, is, as a matter of course, accepted by the author. We commend this old notion to the neo-mystics of the day. It is, at least, as worthy of their notice as the notion of the four elements which they seem bent on reviving.

The Glossary may be pronounced a curious and interesting contribution to the history of medical science.

Land Nationalisation, its Necessity and its Aims. Being a Comparison of the System of Landlord and Tenant with that of Occupying Ownership in their Influence on the Wellbeing of the People. By ALFRED RUSSEL WALLACE. London: Trübner and Co.

WE are second to no man living in our respect and admiration for Mr. Wallace. But he has unfortunately chosen a subject which lies entirely outside the competence of the "Journal of Science," and which we are therefore quite unable to discuss.

Records of the Geological Survey of India. Vol. XIV., Pert 2. 1881.

We find here notes of Mr. R. Lydekker, F.Z.S., on certain Gondwána Vertebrates. There is mention of the mandible of a labyrinthodont differing from any known European or American fossils hitherto known; the skull of *Gonioglyptus longirostris*, a crocodilian from the Rewah Rocks; a *Hyperodapedon* from Rewah, indicating a much larger animal than any hitherto known, and probably about 16 feet long. The same author communicates a paper on the ossiferous beds of Húndes, in Tibet, in which it appears that all the extinct Siwalik forms are absent. There are indications that the climate of Tibet must have been at one time much milder and moister than at present. Cunningham has shown that shells, now found living at heights not exceeding 11,000 feet, are found fossilised at 15,000.

In some notes on the Mining Records we find that the total yearly output of coal in India is at present only 1,000,000 tons. The writer, Mr. T. W. H. Hughes, F.G.S., comments on the exclusion of women and girls from underground employment in English mines, which if extended to India would wofully reduce the available labour. He adds, "Until education and civilisation have penetrated more deeply into the mind and system of our female Bauria and Sontal colliers, we may defer placing them on the same platform as the British miner's wife and daughter." Mr. Medlicott adds, very appositely, "or perhaps until the vices of 'civilisation' have degraded the male element of these simple people to the moral level of a large part of the British mining population."

Mr. Mallet, F.G.S., communicates an interesting paper on the Cobaltite and Danaite of the Khetri mines of Rájputana, first discovered by Mr. J. Middleton, F.G.S. The cobaltite in question is remarkable for its purity, and contains 64·64 per cent of cobalt. It is used by Indian jewellers for imparting a delicate rose-colour to gold, but the process they employ is guarded as a secret. It is remarked that mineralogical text-books disagree on the behaviour of cobaltite in the closed tube. The author finds that, whils mispickel gives a sublimate at a moderate red-heat, cobaltite and glaucodot remain unaltered until the temperature at which glass softens.

Vol. XIV., Part 3. 1881.

In this issue we find an important paper by Mr. H. B. Medlicott on Artesian Borings in India. The want of water being so frequent and disastrous, it is only natural that the attention of the Geological Survey has been turned to these wells as a possible remedy. At the French settlement of Pondicherry an excellent supply has been obtained. In other parts they have either proved failures or the results—as in the plains of Upper India—are still indecisive. The writer very justly considers that Government ought to undertake the settlement of so momentous a question. It is a sad fact that much of the water consumed in India, by Europeans as well as natives, would in this country be condemned as unsafe.

Mr. P. N. Bose, B.Sc., F.G.S., discussing the fossil hyænas of the Siwalik, upholds the specific distinctness of *H. Sivalensis* and *H. felina*. He maintains that the measurements of the upper true molar in the "third skull" (Indian museum, No. 47), as given by Mr. Lydekker, are incorrect. Instead of 0·4×0·23 inch the dimensions should be 0·6×0·25. In *H. felina* the maximum transverse length is only 0·225, and the antero-posterior length 0·08. Hence the "third skull" does not agree in this point with *H. felina*. The latter species makes distinct approaches to the feline character, and the skull, though essentially hyænoid, cannot be brought under any known species of hyæna.

Mr. Lydekker had objected to the separation of *Machairodon Palæindicus* from *M. Sivalensis*. M. Bose replies that the difference in the structure of the lower jaw is considerable, *M. Palæindicus* departing in this respect from all other known species of the genus, *M. Sivalensis* included.

Vol. XIV., Part 4. 1881.

This issue contains important suggestions by Mr. H. B. Medlicott, on the Unification of Geological Nomenclature and Cartography. His remarks, which have been embodied in a note sent to the International Geological Congress of Bologna, relate to a very difficult question. The author points out that any attempt at a rigorous definition of signs,—whether nomenclature or the colouration of maps,—as intended for universal adoption, will be of doubtful expediency. As an instance he gives the Gondwána system of India: its base is of Permian age, and its top beds Upper Jurassic, being the homologue, though not the equivalent, of the secondary series of European geology. Yet it is a "system," and even a "formation," in the restricted sense proposed for these terms, in which no clear division over the whole area can be traced. In order to represent upon maps divisions within a system, he proposes a system of fine black lines, the direction of which is significant. A horizontal (or east—west) line is used for the lowest, and a vertical (north—south) for the highest. Four intermediately inclined lines stand for the intervening divisions. Thus six clear divisions are produced within each shade of colour, and if we take three shades for each colour we get 18 divisions for one colour. Continuous lines may be used for the primary divisions, and broken lines for the secondary.

Vol. XV., Part 1. 1882.

In this issue Mr. Lydekker, F.Z.S., gives a note on *Hyæna Sivalensis*, and shows that the skulls discovered cannot well be referred—as is done by Mr. Bose and Dr. Falconer—to two species, and that the *H. felina* of Bose must be given up. The author, however, holds that Mr. Bose was justified in his opinion by the few specimens before him.

Mr. Lydekker has studied the limb-bones and cervical vertebræ of the fossil Siwalik giraffe-like and sivatheroid animals in the Calcutta Museum. The fossil giraffe of the Siwaliks was very like the existing African species in the proportions of its limbs. Nearly approaching this giraffe is a long-limbed ruminant,—perhaps a *Vishnutherium*,—whose leg-bones are shorter than those of the true giraffe. Next follows *Hydaspitherium*, with leg-bones shorter and stouter than those of *Vishnutherium*, but longer and slighter than those of *Sivatherium*, in which the proportions are those common among ruminants. Mr. Lydekker, whilst pointing out this instructive gradation of forms, is not prepared to assert that such is the actual line of evolution of the giraffes. He considers that the families Camelopardalidæ and Sivatheridæ should be united. The skull of a large hornless ruminant from the Siwaliks, hitherto supposed to be the female of *Sivatherium giganteum*, is now referred to *Helladotherium*, and is probably the *H. Duvernoyi*. The right scapho-lunar bone of a large cat has been found in the alluvium of the Jamna. It is slightly larger than that of the Bengal tiger, but presents so little difference that it may belong to the same species. Mr. Lydekker is not disposed, without further evidence, to admit that the Pleistocene tiger was the same as that of the present day.

CORRESPONDENCE.

⁂ The Editor does not hold himself responsible for statements of facts or opinions expressed in Correspondence, or in Articles bearing the signature of their respective authors.

KOSMIC IDEAS: A THEME FOR THINKERS.

To the Editor of the Journal of Science.

> " Look here, upon this picture, and on this ;
> The counterfeit presentment of two brothers."
>
> HAMLET, *Act* 3, *Scene* 4.

First Picture.

THE scientific formula of Creation, as propounded by the Professors, is that MATTER is the predominant all, containing within itself, as self instituted, Life and Mind and Consciousness, all of which were evolved from "*the fire mist.*" Thus incandescence was the true reality ; substances were separated, form eliminated, and by the action of force became phenomena,—blindly rushing hither and thither, accident became order, through its endless repetitions, and by an inherent necessity the Universe is interpreted by the senses only.

Second Picture.

Intelligence was impersonified.[*] God is ; from whom came design and order (*i.e.*, the intimate dependence of part on part, and of each with the whole design). The impulse arose in the great arcana of thought ; it was life. Light became apparent ; the Universe evolved with phenomena as its incidents. In consciousness sense became knowledge by reflection.

In *Self* and *Self Interest* the difficult problem of Man is contained—for in their distinctions are Morals and Religion : in the first are all the instinctive influences ; in the latter, Man's intelligence.

S. BILLING.

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[*] Impersonified : the word is used in a figurative sense, because I know no other word which will explain my meaning ; but this I may say—there is no personification excepting in intelligence, *i.e.*, in the consciousness of being.

THE LOCOMOTION OF SERPENTS.

To the Editor of The Journal of Science.

Sir,—It seems to me that the locomotion of serpents has not been sufficiently studied. Is it not probable that new light might be thrown on this subject by the use of the instantaneous photographic revolver? My reason for calling the attention of your readers to this matter is that a belief prevails in South Africa, and elsewhere, that certain snakes roll along like a hoop. A young man, just returned from the Orange Free State, tells me that he has witnessed this phenomenon; but such a mode of travelling seems so unlikely that I am exceedingly sceptical, and should like further evidence.—I am, &c.,

Serpent-Hunter.

ANTI-VIVISECTIONIST DOCTORS.

To the Editor of the Journal of Science.

Sir,—I should advise all medical and other scientific gentlemen who may find it their duty to watch or oppose the proceedings at Anti-Vivisection meetings to insist upon learning the qualifications of "doctors" brought forward to declare experiments upon animals useless. I have heard it hinted that some of these worthies hold diplomas not recognised in the United Kingdom. —I am, &c.

Lynx.

NOTES.

Our attention has been called to the following letter in the "National Reformer":—"The Anti-Vivisectionists have already earned an unenviable notoriety by their reckless statements and their indifference to rigid accuracy. Another instance of this failing has occurred in reference to myself. A few days ago an official from the Society for the Prevention of Cruelty to Animals called upon me. The official was courtesy itself, but he was obliged to inform me that a communication had been received by the Society to the effect that I was in the habit of performing vivisections almost daily; that I had many students who took part in these experiments; and that many carriages, bearing fashionable ladies, came to my door. To all these statements I gave a most emphatic denial. Every one of them is entirely false. Since I have been at Newman Street I have never performed one act of vivisection. I have not that license which places scientific investigators, in one respect, on a level with tobacconists and publicans. No pupil of mine has ever seen a vivisection performed by me. The carriages and the fashionable ladies and gentlemen come to visit an estimable maker of guns who lodges beneath me. The official and Mr. Colam, the secretary, have accepted my assurance that the whole of the charge made is false. They believe that only dead animals are dissected in my laboratory. But, after the false witness and the ignominious fiasco, the fact remains that some person—certainly an untruthful anti-humanitarian—has told falsehoods in respect to myself, possibly with the object of injuring me; certainly with this result, that the opposers of scientific investigation are once more shown to be as unscrupulous as they are bitter.—Edward B. Aveling, D.Sc."

The conduct of Prof. E. Ray Lankester in rejecting the Chair of Natural History at Edinburgh, almost as soon as he had accepted it, is the subject of much unfavourable comment. Prof. Huxley declares that Mr. E. Ray Lankester had been fully informed of all those conditions and arrangements which he now assigns as the grounds for his resignation.

Dr. J. Crossar Ewart, heretofore Professor of Natural History at Aberdeen, takes the Chair at Edinburgh so unexpectedly vacated.

Prof. H. Alleyne Nicholson, of St. Andrews, whose works we have repeatedly had the pleasure of bringing under the notice of our readers, succeeds Prof. Ewart at Aberdeen.

We are glad to learn that public meetings are no longer so easily gulled by Anti-Vivisectionist agitators. At Sheffield a large majority of votes was given against them, and at Richmond they did not venture to submit any resolutions to a meeting which they had got together.

The "Medical Brief" is discussing the question of maternal impressions, and recording cases both where they have occurred and where they might have been expected to occur, but did not.

Intelligence of the death of Johann Karl Friedrich *Z*öllner, the great physical astronomer of Leipzig, did not reach us in time to be noticed in our May issue. His theory of the possible existence of a fourth dimension in space has given rise to much unworthy ridicule, and has certainly not been clearly demonstrated. But no thinking man can deny that our conception of the universe might be greatly altered if our faculties were enlarged or modified. The deceased was only in his 48th year.

Reinke ("Pflüger's Archiv") argues for the non-existence of electric currents circulating in the living cells of plants.

According to MM. Macé de Lepinay and W. Nicati ("Journal de Physique") transitory colour-blindness is produced by a stay of a few hours among snow-fields illuminated by the sun. All artificial lights appeared green for a short time. The exhaustion of the retina for the perception of red is more prolonged than for other colours.

Backlund ("Bull. de l'Académie Imp. des Sciences de St. Petersbourg") has examined the evidence for the existence of a resisting medium in space, but has arrived merely at a negative result.

The "Neues Jahrbuch für Mineralogie" contests the widely-spread notion of the archaic character of the deep-sea fauna.

M. J. Gaule ("Revue Scientifique"), on examining the red globules in the defibrinated blood of frogs, heated to 86° to 88° F. in a solution of common salt at 0·6 per cent, saw in the cellule, along with the nucleus, small movable corpuscles, elongated and pointed at their ends. These cytozoa are apparently the result of death; a part of the cellule dies totally, whilst the other becomes so much the more active, survives the cell, and becomes free.

M. Delaunay ("Les Mondes") makes some remarkable statements concerning dreams. By covering the forehead with a layer of wadding dreams can be rendered sane and rational. The position of the sleeper is also of importance. If he lies on his back the dreams will be sensorial and erotic. If on the right side they will be mobile, full of transition and exaggeration, absurd, and relating to old events. If on the left side they are intelligent, reasonable, and refer to recent affairs.

The appointment of the Fellows and Examiners of the new Royal Irish University has taken place, and has given room for no little discussion.

The medical papers give several instances of larvæ, apparently Dipterous, having been found in human subjects in this country. It is important to know whether such phenomena have been recorded formerly, or whether some Dipteron has recently become parasitic on man.

Capt. E. L. B. Davis writes to the "Popular Science Monthly" to protest against its insertion of quack advertisements. The editor, in reply, disavows responsibility for the advertisements, and hints that it would not be easy to exclude them.

Prof. Ladolei denounces as "materialistic" the opinion that plants possess sensation and will.

M. Colasanti ("Les Mondes") finds that Lepidopterous chrysalides may be submitted for forty-eight hours to a temperature of – 12° C. without injury. He exposed butterflies to the same temperature, and found that on restoration to a normal temperature they all revived. On being thus frozen and restored for three successive times they became weaker.

S. Ambrogio ("Les Mondes") proposes the law that the physiological action of organic substances is "directly as their specific heat, and inversely as their molecular weight," being the reverse of the action of the metals.

Dr. Paterson, of Bridge of Allan, writes to a Glasgow paper that the mavis has, during the last thirty years, grown progressively scarcer in Scotland, and will ultimately become extinct.

Mr. R. C. Rutherford explains the phenomena of odours by the vibrations of an "odoriferous ether" analogous to, or possibly identical with, the luminiferous ether.

Prof. R. Owen has received a gold medal of honour, instituted centuries ago by the Dukes of Mantua, and of which Dante, Michael Angelo, Raphael, and Cuvier have been previous recipients.

There is a division among the Occultists. Swami Dayanund Suruswati Pundit, the elected Director and Chief of the "Theosophical Society of the Arya-Somaj," now declares that Colonel Olcott and Madame Blavatsky know nothing of occult science as practised by the Yogis of old!—*Light.*

M. Lemoine ("Comptes Rendus") gives an account of the skulls of *Arctocyon Dueilii* and *Pleuraspidotherium Ammonieri* from the lower eocene near Rheims. The former of these mammals is a carnivorous type; the latter combines the characters of the Marsupials, the Pachydermata, and the Lemuridæ. In both the quadrigeminal tubercles appear to have been completely uncovered, and little inferior in diameter to the cerebral hemispheres —a condition approximating to that of the present crocodiles and tortoises.

Allantoine has been detected in the young leaves of the birch, horse chestnut, and plane, by E. Schulze and J. Barbieri.

From observations made by friends of the Editor in the neighbourhood of Epping Forest, the squirrel must rank among the greatest enemies of our small birds, as it destroys their eggs. It also plunders the adjacent gardens, and gnaws away the sunny side of a peach with much judgment. Its chief enemy is the carrion crow, which thus to some extent atones for its raids upon chickens and ducklings.

The crow has been seen watching a hollow tree in which the starlings have their nests. As soon as one of these birds sallied forth it was seized, stripped of its feathers, and torn to pieces. Waterton's "warrior bird" is not to be trusted.

At a recent meeting of the Quekett Microscopical Club Mr. A. D. Michael called attention to an object exhibited in the room, and illuminated with polarised light. In both animal and vegetable tissues considerable differential colouring was often evident, and this in the case of substances which had not been subjected to the more or less disturbing influences of bleaching and staining. Upon the whole Mr. Michael considered that the appearances developed by the polariscope were more natural than those produced by other means. There is little doubt that sufficient use is not made of the polariscope in the examination of tissues; in many hands it is still only a toy. In Petrology it has done wonders; rocks, sections formerly considered structureless, have shown themselves to be anything but homogeneous in their constitution.

The Quekett Microscopical Club have issued a general index to the first six volumes of their Journal, published between the years 1868 and 1881. Both author's names and subjects are alphabetically arranged, and matter elicited during discussions at the meetings is included, as well as the written papers. The index will prove useful to those engaged in the very difficult search after what has been written, as well as to members of the Club.

Under the title "Studies in Microscopical Science" a new work is announced for publication by subscription, by Mr. A. C. Cole, F.R.M.S., assisted by several eminent specialists. The most remarkable feature in the publication is the issue of a microscopical preparation, accompanied with a printed description containing the literature concerning it, the habitat, &c., the methods employed in its preparation as a means of study, its principal features, and any necessary additional remarks: there will also be a lithographed or engraved drawing or diagram of the preparation. The first year's issue will include a series of twenty-six histological, eighteen botanical, and eight petrological preparations. There can be no doubt of the high educational value of the work. Mr. Cole's preparations are well known to students, and the list of contributors to the literary department promises well for the success of the undertaking.

At the May meeting of the Entomological Society there was exhibited a hybrid between *Antheræa Pernyi*, the oak-feeding silkworm of North China, and *A. Roylei*, an oak-feeding silkworm of the Himalayas. It was remarked that the insect fauna of North China has much stronger Himalayan affinities than that of Middle and South China. Hence the question was raised by Mr. R. McLachlan, F.R.S., whether the two parent forms, which have a very close morphological resemblance, were truly distinct species or mere local varieties.

Mr. Ryder ("American Naturalist") reports on experiments to delay the development of fish eggs for convenience of transportation. At 53° F. development was slow, but normal, up to a certain point, when a fungus was formed upon the egg-membrane. Below 53° the development became abnormal, and 43° proved fatal. Prof. Brocks finds in oyster eggs the phenomena of segmentation and nuclear division, and Mr. Ryder holds that there is a direct relation between these phenomena and heat as a mode of motion.

We are glad to see that the Dublin Society for the Prevention of Cruelty to Animals, in appealing for wider support, finds it advisable to add—"*No connection with any Anti-Vivisection Society*." This is a healthy sign of the times.

M. H. Filhol ("Comptes Rendus") states that P. Gervais has discovered, in the Upper Eocene of Débruge, remains of a mammalian form allied to the Suidæ. This form, to which P. Gervais gives the name of *Cebochœrus*, offers analogies with the Simiadæ in the form of the molars, the elevation and the shortening of the cranium, and the form of the temporo-maxillary articulation.

The Congress of German Naturalists and Physicians will meet this year on September 17th, and the American Association for the Advancement of Science on August 23rd, at Montreal.

Sir J. Lubbock ("Journal of Linnean Society") concludes, from a prolonged and careful series of experiments, that bees distinguish colours, and have a decided preference for blue.

M. Couty, of the Museum of Rio de Janeiro, states, in a communication to the Academy of Sciences, that potassium permanganate has been recommended as an antidote to snake-poison without sufficient experimental proof. It does not annul the action of the poison when the latter has penetrated into the blood or into the tissues.

Mr. Meehan ("American Naturalist") calls attention to two forms of willow-leaves from the same tree,—one form an inch in width, and the other not more than a line,—and argues that this tends to show the production of variations by sudden leaps.

The manipulative details of Mr. J. W. Stephenson's process for mounting microscopical objects in phosphorus is published in the April number of the "Journal of the Royal Microscopical Society." The operation should on no account be attempted by any but those accustomed to the use of dangerous chemicals; the value of the results has already been noticed. The same paper also contains an account of the process of mounting in a solution of biniodide of mercury in iodide of potassium. This medium, although not so effective as the solution of phosphorus, will be found of great value, owing to its high refractive index and capability of dilution; the manipulation presents no difficulties to those used to the mounting of objects in fluid. The density of the medium is so great that flint glass floats in it like a cork.

Mrs. S. E. De Morgan, writing in the "Psychological Review," a Spiritualist organ, says—"But the Positivists and Comtists encourage feelings of benevolence, sympathy, and justice above all things, regulating and limiting the inroads of Science [!] by their dictates, and setting themselves so far in the road to truth. The enlightened Positivist, Dr. Bridges, is one of the most able writers against Vivisection."

On the other hand, "Ouida," in a rash outbreak against Vivisection, which we regret to say has been permitted to appear in the "Gentleman's Magazine," declares "that the vast and ever-increasing body of persons who are opposed to any form of religion has conceived that in encouraging Vivisection it encourages Free Thought."

Mr. T. E. Espin ("Monthly Notices of the Royal Astronomical Society") proves β Ursæ-Minoris to be a variable star, having a period of about ten and a half days. At its minimum it seems to be of a redder colour.

Prof. O. C. Marsh ("Geological Magazine") examines the wings of the Pterodactyles, and shows that they were true organs of flight, and not of natation. He gives a restored representation of *Rhamphorynchus phyllurus.*

On May 5th a lecture on poisoning with aconitine was delivered —before the Balloon Society of Great Britain!

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THE

JOURNAL OF SCIENCE.

JULY, 1882.

I. VEGETABLE SOIL.*

By G. H. Kinahan, M.R.I.A., &c.

(Concluded from page 341.)

Stones on the Surface of the Ground.

Dr. DARWIN seems to be of the opinion that the burying of surface stones is principally due to their being undermined and lowered by worms burrowing under them: this, however, does not appear to be proven. In my previous publications I have given facts which show that vegetable growth and decay, as also ant-work, are efficient workers; not, however, as lowerers of the stones, but as builders up of earth around them. Surface stones are natural equalisers of the temperature, keeping the ground near them cool in summer and warm in winter, some stones being better conductors of heat than others; therefore immediately around them there is more vegetable growth and decay than elsewhere in the same field, as will be seen in innumerable places in the stony portion of Connaught and Munster. This vegetable growth and decay, especially if the stone stands a foot or more over the surface of the ground, is greatest opposite the sun at 11 o'clock a.m.; and if the stone is on a flat surface, and the increase of the soil is *solely due* to vegetable growth and decay, the earth will increase fastest to the S.S.E. of the stone. These results, however, are nearly always modified, as rain and rivulets may carry matter and lodge it at other sides of the stone, or winds will carry dust and make accumulations. The prevailing wind of a district is a great auxiliary in burying a stone, as nearly daily it carries a few particles of dust and lodges them in the growing plants, thus promoting their growth. Some ants also always patronise these stones, beginning their work at the sunny side, from which they rapidly carry their accumulations on to it; while worms ought to work most to the north or damp side, which often is the last to be covered, or is left uncovered.

---

* This paper was written prior to the death of the eminent philosopher, Dr. Darwin, and was ready for the press when his lamentable death was announced, which consequently delayed its publication.

In Ireland there are numerous megalithic structures, and with excavations about such I have at different times been connected. In Glenbonniff, near Feable, Co. Clare, there are *fosleacs,* or flag dwellings, one of which was excavated by my brother, the late Dr. J. R. Kinahan, over thirty-five years ago. When he began it was completely covered over by vegetable matter (peat), and stood intact as when first erected on the old surface of the ground. I have since again visited this place, and since he was there other similar structures, similarly circumstanced, have been exposed by the turf-cutters. These structures were solely buried by vegetable growth and decay.

In Ballykean, near Redcross, Co. Wicklow, there are a number of "cupped stones," some still standing well out of the ground, while others are nearly buried. To try and find out what was the original use of the cups, or at what time the cups were made, I excavated about some of them. Those that were more deeply buried (some were then nearly covered up, although all were to be plainly seen at my first visit four years before) had about 18 inches of vegetable soil alongside, which was far in excess of the average depth on the rest of the field (about 8 inches), but all rested directly on a shingly substratum, the same as the subsoil under the rest of the field, into which, in no case, had they sank, although in some cases it was evident that when the land was first tilled (it had been a wood 200 or 300 years ago) holes alongside the large stones had been dug, and the smaller stones buried in them. Similarly with all the megalithic structures that elsewhere I have excavated about, they rested on the natural subsoil similar to that under the vegetable soil of the adjoining ground. In the case of the Ballykean cupped stones I believe the great growth of soil, in the four years previous to the time the excavations were made, was principally due to the grass during the last two years not having been cut for hay, but having been left as winterage for cattle.

In many of the prehistoric feartha, or burial-places, the kistveans were at or near the surface of the ground, and at the present time they nearly invariably are at or near the surface of the ground. In Ireland the prehistoric people usually made the kistvean about 2 feet square and from 12 to 15 inches high, the sole stone of the kistvean being on the subsoil, or slightly below its surface. Thus the structure originally was more or less above the surface; but now, although above the surface of the adjoining ground, the kistveans are usually covered with soil which have evidently grown up and covered them,—often the work of ants, at other times nearly solely due to vegetable growth and decay. In this class of feartha the dead were burned, and their ashes placed in the kistveans either with or without urns, so that there were no great inducements for worms to congregate at such places; but there are other feartha, like that at Mervinstown, near Dunlavin, Co. Wicklow, where unburned bodies were buried in the kistveans, which must have been an inducement for the worms to congregate and burrow below in the adjoining soil; yet in no place were the stones displaced and put out of gear by the worms burrowing under them. There are other prehistoric graves to be found on the west coast where the corpses were enveloped in sea shells. Sections of such graves may be seen in places where a stream or the sea—as at Ballinskellig, Co. Kerry—has cut away a portion of the graveyard; but in no place that I have seen was *the original bottom* of the grave disturbed, the growth of soil above the grave having no connection with the removal of the soil or clay alongside or below it.

While geologising the West Galway hills I had occasion, during the autumn of 1872, to walk along the grassy Silurian slopes between Maumturk and Leenaun, and my companion, as we went along, amused himself by rolling down the slopes the different surface stones: this was not, however, altogether useless work, as we wanted to learn the origin of certain accumulations of blocks in the bottom of the valleys. Some of the stones he could easily set rolling, while others I had to assist him with, which led me to observe that all the more or less buried stones had new or old ant-works alongside, while those that lay nearly on the surface had only worms and beetles under them. I should mention that these stones were stones that in the winter had been loosened by frost or other weathering from the cliffs above, and had lodged on their way down. As it is the general practice with the shepherds to set all the lodged stones "a rolling," in the spring, to "clear the grass," most of the stones we met with had not been there six months; but some, that had the old ant-hills alongside, must have been there from the year before. Such observations, then first made, have since made me, in many other localities, to turn over the surface stones to see what buried them, and nearly invariably my general conclusions have been that it was mostly due to vegetable growth and decay, except in an ant country.

In May, 1881, I had occasion to visit the great Saltee, off the South coast of Wexford, and in one cliff numerous birds were nesting. As I wanted to know what kinds of birds were there, I got my companion to go and roll down stones over the cliff. He had never previously seen so many birds congregated together, and when I joined him he asked me if I would roll down some stones that he might see the flight. While he was going round to the opposite side of the coose, I employed myself raising stones to roll down, which I found very difficult to do, as all were nearly entirely buried in a sort of peaty soil. This I could not at first account for, as there was no ant-work,—nor a worm to be seen,—while the peat was of a class evidently not solely due to vegetable growth and decay. After carefully examining the place the only conclusion I could arrive at was, that, during the prevalent winds from the S.W., the *débris* of the peat and of the granite was blown from a neighbouring gap and lodged here; it subsequently being consolidated by vegetable growth.

The Irish ants have distinct peculiarities. One species affect moist low ground, on which they build high pinnacles, keeping to the same place year after year; others keep to the stiff upland, where they work very similarly; while another kind keep to the wild land, where they make large flattish hills; but those with which we are now interested always plant their colony at a surface stone. Of the latter the first colonists seem to take up their abode under the stone, and make innumerable galleries and cells to lay their eggs in: this is generally in April and May, but this year (1882) I found them working in the latter end of February. As the weather gets warm they extend their work to the outside, and gradually creep up on it. The stone appears to be used as a generator of heat, or, perhaps more correctly, as an equaliser of heat (stones on the surface of the grass promoting heat in winter and cool in summer), because when a stone is entirely, or nearly entirely covered, the ants will leave it. Some of the ants are extraordinary workers. In parts of Clare and Galway the crags of mountain limestone are perfectly bare; yet I have seen a colony of ants take a fancy to a stone lying on one of them, and build an ant-hill against it. Where they got the materials to build the hill it is hard to say, unless they travelled all about the surface of the crag and picked off its surface the minute disintegrated particles. In such cases it is evidently a building-up process which buries the stones. This is quite an exceptional case, as you might travel these crags for weeks before you met such an ant-hill. In fact at the present moment I can only remember one locality in which I saw them, and that was in Glencolombkill barony of Burren, Co. Clare, but I think I also saw them elsewhere.

Worms leave a stone that ants come to, but after the ants have left it you will find worms in the old ant-soil, and their castings on the old ant-hills. Worms seem to have an antipathy to ants. I have over and over again put them travelling towards an ant-hill, and in a few cases they have gone straight on into it, but in general they appear to smell the ants, and suddenly will begin to travel backward, and get away as quickly as possible. If he goes into the ant-hill he is stung to death nearly immediately.

In May, 1881, a flat stone, 2 feet long by 10 inches wide, and nearly 3 inches thick, was put on the surface over a dog's grave in a rhododendra shrubbery; the grass was cut about July, but the after grass was let rot; and in January (1882) the stone was nearly covered, there not being a trace of worm-work alongside or over it, while under it were two worms and some beetles. I expected that, as the dead grass around and over it formed into mould, the worms would appear, but when I again examined it in the beginning of March I could not see a trace of one, and on raising the stone I found a colony of ants there, which evidently had hunted away the worms.

In Ireland, as a general rule, if you unstone or clear land (that is, take the large surface blocks off it), let the land be mountain slopes or lowland, you find most or all of the erratics resting on the subsoil, and buried more or less in vegetable soil. From this it would appear to me that the stones could not possibly have sunk, but that the soil must have grown up around them. Most of this stony land was cleared of its woods between 200 and 300 years ago; some, however, at a later date. The usual character of these tracts of stony ground, before they are reclaimed, is a mossy or heathery waste,—or a rushy or swampy tract, in which ants may work, but no worms, except in very isolated spots; but after they are stoned, drained, tilled, and eventually laid down in grass, they are as much frequented by worms as any other grass land. I reclaimed, thirty years ago, about 30 acres that were in part a swamp and in part a heathy waste, and now it is in grass land and full of worms, which could not live in it formerly.

Buried Antiquities.

In Chapter IV. of "Vegetable Mould and Earth Worms" the author intimates that the antiquarian is often indebted to worm-work for the preservation of antiquities, and he brings forward prominently the curvature of the floor of buried buildings and the curvature of the surface of the ground over buried ruins in support of the case. But might not these things happen without the aid of worm-work?

Let us first consider the iron arrow-heads he mentions as found in surprising numbers on the northern side of the Severn, not far from Shrewsbury. These arrow-heads apparently were originally dropped on the surface of the ground; and if the worms worked their best, and the years were the most favourable for worm-work, the worms could not have covered them up in two or three years, or more, during which time many of them would have decayed away. But if a battle was fought on the place, and especially if much blood was spilled, the vegetation afterwards would have been most luxurious, and during the succeeding summer it would have taken a cute observer to detect an arrow-head without digging up the ground. These arrow-heads "were found at the bottom of the furrow,"—that is, at one regular depth below the surface; vegetable growth and decay would bury them at one regular depth, which worm-work could rarely do. A few years ago, near Donnybrook, Co. Dublin, the burial-place of a Norse Viking chieftain was discovered, which has been described by Dr. W. Fraser, F.R.C.S.I., in the "Proceedings of the Royal Irish Academy," 2nd ser., vol. ii. (Pol. Lit. and Antiq.), p. 29. I assisted him one day during his excavations, and from my observations, and those published by him, these prehistoric remains were all on one regular surface, over which the soil had since grown. When I was there a large surface of the mould had been cleared away, leaving an even surface above which no remains were found, all being immediately under it. Some of the remains had originally been left on the surface of the ground, such as "fire-heaps" and heaps of human heads, while some of the bodies had been buried in rude trenches; and the buried trenches, the "fire-heaps," and the heaps of human heads had not been disturbed since they were first made or placed, the mould evidently having grown over them, and not having been brought up from under them. Similarly, in other places where I have made explorations, I have found that antiquities lie on regular old surfaces, which your workmen soon learn to recognise and keep to, and are rather disgusted when you make them hole it in places, to see that they are not leaving anything of interest behind them.

Lime or ashes, originally laid on the surface of the ground, as mentioned by Darwin, are found buried in layers. This subject I treated on in my former writings, and pointed out that if worms covered them by mould brought up from under them, the layers must have become distorted and uneven Now I would mention a somewhat allied case that lately came under my observation.

As I have pointed out in my little book on the "Reclamation of Waste Lands in Ireland," "beatin"—that is, burnt sods or vegetable mould—was formerly extensively used by the poorer farmers in Ireland until stopped by Acts of Parliament passed in the reigns of George II. and George III. Whilst traversing the hilly country westward of Shillalagh, Co. Wicklow, I came on about a quarter of an acre of land with rows of heaps on it, which, on picking into, I found to be heaps of beatin covered with a coat of from 3 to 4 inches in depth of vegetable mould. It was evident that many years ago the patch was "scrawed," and the scraws or sods, after they were dried, had been collected in rows of heaps and burned into beatin; but for some reason the reclamation was then stopped, and the heaps of beatin left unspread. The heaps are still intact, except that coats of mould have grown over them, and this could not have been brought up by worms from underneath. There were no traces of worm-work in the land about them, which was mossy and heathery; neither could I see any on them; but it was rather late for worm-work (the end of April), and possibly it would be seen if they were visited in the winter.

Curvature of Floors and Surfaces over Old Buildings.

In the spaces between the walls of any building, without worm-work,. the ground away from the walls must shrink more than that in contact with them. Passages in houses are usually paved, or tiled, or flagged. If paved, the centre nearly invariably is much higher than the side, while if it is tiled they are laid even; in either case you put under the stones or the tiles materials that worms cannot burrow in, yet, although the foundation has been made as compact as possible, after a time the centre of the passage will sink: if you flag the passage, and all your flags do not extend the full way across, after a time the short flags will sag downwards toward the centre, and will have to be reset. Floors of rooms paved, tiled, or flagged will curve more rapidly, the flags often breaking up. The first office I was in, was that of an engineer and architect, and part of his business was looking after house property in Dublin, a duty I was often employed on. I was ordered to go and examine a first-class house in Upper Mount Street, occupied by a Col. R.E. It was not a hundred years old, as it had been built after the year 1798, yet the kitchen floor, which was flagged, had sagged at the centre over 6 inches. I found that originally the flags had been most carefully set on about 9 inches in depth of rubble, over which was a coat of mortar: no worms could have worked here. In stables the centre of the stall will nearly invariably go down, and under the pavement you will find gravel more or less impregnated with the ejecta of the cattle, which alone would prevent worm-working under the stones.

In 1850 and subsequent years many of the Irish callows and other flooded flats were drained. Some of them, such as those near Strokestown, Co. Roscommon, were level before they were drained, but after the water was taken from them they began to contract and show irregularities, the walls of crannogs standing up, while the surface inside them sagged down. No worms could have worked here till after the water was gone. It may be said that this is an exceptional case, but still I believe it has a bearing on the subject, because in a confined space, such as a room between old walls, the contraction must be greater away from the walls than in contact with them. In a letter from Mr. Lee, of Caerleon, written some ten years ago, he mentions that Roman remains in his neighbourhood were discovered during a very dry summer by ridges forming on the surface of the ground, the contraction over the walls being less than in the spaces between them, although the walls were from 5 to 6 feet from the surface.—(" Valleys and their Relations to Faults, &c.," Appendix, p. 234.)

If a number of worms excavated under a wall, of course it must go down; but would it go down evenly and regularly? and what would the worms go there for? Except at such times as the worms go down deep to hybernate, during dry warm or cold weather, they appear only to tunnel in search of food, which rarely they would find under the foundation of a wall; and I suspect, if any of these old Roman walls were cleared out, their foundations would be found to lie on the regular floors on which they were originally placed. At least such has been my experience in connection with the walls of the prehistoric structures in Ireland.

As yet I have seen nothing that will explain the exceptional deep burrowing of worms, also where they come from. Often in deep soils, apparently favourable for worm-work, you will not find a worm or the trace of a worm; while at other times, at great depths, you will find them in stuff that you would think they would not burrow in. Bury vegetable or animal matter, and as a general rule it will breed worms, but sometimes it will not. Bury horse stable manure, the horses having been fed on hard dry food, and until it is perfectly rotten there will be no worms in it; while bury cow-house manure, even under clay well tamped down, and in a short time it will be full of worms, while not a trace of them can be seen on the surface of the ground. Brandlings are a peculiar worm thought much of by fishermen: I am not a fisherman, but some of my youngsters are, and they have colonies of brandlings in heaps of manure, out of which they do not seem to stir. (Note, p. 387). These worms do not appear to be generally distributed, yet in the spring of the year, if you go into old turnip land, or the like, and dig under the heaps of turnip-tops or weeds, you are sure to get some. Where do they come from, because at other times they will not be found?

Put in a trench layers of cow-manure, and layers of clay or rubbish, such as broken up old lime or ashes, and after a time in the manure you will find lots of worms, but none in the intervening layers. Similarly, in excavations in old ruins, if you find worms they are in the layers of decayed vegetable or animal matter, and not in the other stuffs. But often, even in the favourable matter, none may be found when it is first dug into; you may be digging for a day, and only one or two be turned out, they being so rare that the workmen always remark any that are found. I have also seen some of these explorers got at great depths in callow land, greatly to the astonishment of the men, who cut them up into little bits suspecting them to be a "paisteens," or something else "not right." Some worms go to great depths, which must be allowed by all who have studied them; yet these deep explorers are so few and rare that what work they could do would not be appreciable in millions of years.

Although it has been already mentioned, I may again refer to the worms found in excavations *after they are opened*, as Mr. Ferrer's notes, quoted by Mr. Darwin, seem to confirm my observations, the number of worm casts in his excavations appearing in conformity with the changes of the weather, they being few when it was dry and not favourable for the worms to travel, and numerous when it was damp or after rain. New mortar worms abhor; dry mortar rubbish, such as you get if you pull down an old house, they do not appear to care for; but rotten mortar, such as you get in buried ancient structures, they delight in. This appears due to the chemical changes that have taken place. I knew a gentleman in the county of Longford whose house was next the old ruin of a mill, which he pulled down, and on its site, in the old mortar rubbish, he planted a strawberry bed: this bed for some years would not breed a worm or slug, but after a time, when it had rotted, they came there as elsewhere. The mortar rubbish has part of the sting of the lime left in it; but the rotten mortar in prehistoric structures is now a lime soil, besides being more or less impregnated with vegetable or animal matter imbibed from the rubbish that has filled in and buried the ruin; the worms therefore, as soon as they can get at it, burrow into it, let it be in the perpendicular walls or in the floor. This, however, is not the case always, as in some of these old mortars, before they are opened up to atmospheric influences, I suspect the worms could not burrow, because in such cases I have observed that the freshly uncovered mortar is perfectly hard until it has been exposed to the air for a few days, when it disintegrates and becomes quite friable.

Worms are wonderful workers, but, as I have already said, I cannot believe that—except rarely—they work below the vegetable mould, and therefore they cannot increase the soil in depth. Their great use appears to be in old grass land, where they bring up the mould from among the roots of the plants and top-dress them with it, because, as I pointed out years ago, if you break up grass land *you will find the old tillage floor intact*, *although it may have been buried for years.* The ploughmen of Wexford and Wicklow will show you the floor that their fathers, grandfathers, and great-grandfathers tilled on, and a man who would break through this floor and bring up the "yallar" ground (clay), or subsoil, is considered a bad ploughman. They all have a firm belief that if they bring up the "yallar," or go into the gravel, they spoil the land; this, however, is not a question to be discussed here.

In conclusion I would refer to some deepeners of the soil whose work I have not seen elsewhere recorded, and these are the large copper-coloured and blue beetles called respectively "cockchaffers" and "bumbly bees." The last I have observed this spring in great numbers on the wild hill-slopes of Wicklow, Carlow, and Wexford, they burrowing down into the yellow clay subsoil, and bringing up little heaps about 3 or 4 inches in height and diameter : very interesting work of theirs occurs in connection with cow-dropping, as when three or four burrow under one they bring up enough clay to cover it up, which in a very short time forms a turf of sweet grass. To them therefore, in part, is due patches of good grass in mountain wastes, especially in any sort of sheltered place, as here the cattle at times will herd, while subsequently their ejecta will be covered up by these beetles, thus fertilising the patch : without the beetle-work the ejecta would probably be dried up by the sun, and carried away by the wind, rain, or runlets.

NOTE to page 340.—Some worms are not so careless. On May 23rd, 1882, during the first day of rain after a long drought, I was watching, out of a house in a shrubbery, worms travelling. They were taking their time, elongated to their full extent and scarcely contracting themselves at all, so that they got along very slowly. One came into the house, and when he got on the dry boards he did not seem to like it at all, and raised about an inch in length of his body, with which he felt about for some time ; he then went on slowly, but straight : after the first board there was a hole, into which he did not tumble, as he kept half his body up above, while the other half he bent down at a right angle and elongated it to an extraordinary extent, by which means he was able to touch a dead leaf at the bottom, to which he clung, and then gently drew down the rest of his body.

I have also observed that worms coming out of a hole in the side of a perpendicular trench will try to crawl up or down it ; sometimes they succeed in getting up, especially if they can so elongate their body that the end of the tail remains in the hole while the point of the head is on the surface of the ground ; generally, however, they tumble down to the bottom of the trench.

NOTE to page 385.—During the drought in May the heap got too dry for the brambles, and some of them migrated,—a portion to a large heap of rotten dung in a lane south of the original place, and others to a much dunged border of rhubarb east of the first locality. It is extraordinary how fast they increased in each of these places.

II. THE WAR AGAINST AGRICULTURE.

By An Old Technologist.

I AM about to discuss a startling, and, from a British point of view, a decidedly unwelcome subject,—the attempts now being made to substitute artificial manufactured articles for the produce of the fields, the plantations, and the woodlands. I will at once admit that the title I have chosen is open to objections, since the movement which I am to describe aims in some cases at superseding tropical or sub-tropical products by matters the growth of cold climates. But if I had said "War against Tropical Agriculture" I should have fallen into another error, since one of the principal victims to the movement in question has been an important crop, which but a few years ago was widely grown in France and Holland. However, in these days the title of a book or a treatise is not always designed to throw any very clear light upon its subject, as witness Mr. Ruskin's "Sheepfolds." What I am intending to describe will appear clearly enough below.

The vegetable and animal products which man obtains by agriculture and horticulture arrange themselves into two fairly natural classes. There are, on the one hand, substances which we value for the sake of some one principle which they contain, and which we are generally able to extract and use in a separate condition. This is the case with the bulk of medicinal drugs, dye-wares, condiments, and perfumes. Thus we value opium substantially for the morphia which it contains, Peruvian bark for its quinine and analogous alkaloids, the sugar-cane for its sugar, madder-root for its alizarine, logwood for its hæmatoxyline, the nut of the Elais palm for its oil, &c. Human ingenuity has long ago sought to obtain these valuable and active principles in a state of purity, which, as they are so-called "chemical individuals," has generally proved successful.

With the second class of bodies—such as the grains of wheat or barley, the fruits of the pear-tree or the vine, the milk of the cow, or the flesh of the ox and the sheep—the case is quite different. Here there is no one principle upon which the value of the product depends. There are in such substances a number of chemical compounds, mixed not indeed mechanically, in the usual sense of the word, but physiologically. Let us take the instance of milk: here we have milk-fat, milk-sugar, caseine, albumen, and nucleine, besides galactine, lactochrome, certain mineral salts, and a number of minor ingredients. These various substances, though they are chemical compounds, are not combined together chemically, but exist in a mixture. The physiological action of the milk, as food, depends not upon any one principle which might be extracted and consumed separately, but upon the whole in their ordinary proportions, upon their modifying action upon each other, upon their physiological condition, and their structure.

We might in the same manner examine a grain of wheat, an apple, or a mutton-chop, and find that its value as food depends not on its chemical individuality, but on the joint presence of a number of substances which must be in certain conditions. Thus suppose we were to undertake a comparative analysis of two beef-steaks, the one tender and the other tough, we should doubtless find their composition substantially one and the same. Yet if a man eats the tough steak he will suffer more or less from indigestion, whilst from the tender steak he would experience no unpleasant consequences.

If we turn from articles of food to textile fibres, such as flax, hemp, or cotton, we shall find that though consisting essentially of one and the same chemical principle, cellulose, yet when freed from all foreign matter they still exhibit differences of properties which fit them for different uses, and which depend not on chemical distinctions, but on structure.

If we now compare these two great classes of natural organic products, we find certain very important practical distinctions. Class I., the dyes, medicines, perfumes, &c., are generally much more profitable to the farmer and planter than Class II., the foods, fibres, &c. Again, Class I. is mainly produced in tropical or subtropical climates, whilst Class II. may be raised even in temperate and subarctic regions.

A more important distinction follows: the bodies we have included under Class I., being definite chemical compounds, their artificial production is at least conceivable. Suppose we obtain, through the vital action of a plant, a combination of oxygen, hydrogen, carbon, and nitrogen, in certain proportions: we may possibly get the same elements to combine together in the same proportions without the intervention of the plant, or, in other words, to make the compound in question artificially. In other cases we may obtain the same, or a closely analogous product, through the instrumentality of some other plant. Whether such artificial preparation is possible may depend upon the skill and the perseverance of those who take it in hand, and upon the degree in which the resources of chemical science have been developed. Whether the artificial drug, or other compound, can compete with or supersede the natural product, is a purely commercial question turning upon the cost of the process, but it is unfortunately in many cases complicated by fiscal regulations.

With bodies of the second class the question of artificial production is scarcely conceivable, much less has it been hitherto solved. Let us take the case of milk; the milk-fat, which when separated out is known as butter, is an exceedingly complex body, a mixture—not a compound—of the glycerides of palmitic, stearic, oleïc, butyric, caproïc, caprylic, capric, and rutic acids. We have then the albumenoid bodies, the milk-sugar, and the mineral matters. Now if we suppose that each of the organic compounds just mentioned had been artificially produced,—and this is not the case with even one of them,—we should still be at a loss how to blend them together as they are in Nature, how to give them the correct physical condition, and how to introduce the phosphates of lime and soda, the chloride of potassium, and other mineral salts which are found in natural milk, and which, though but small in quantity, are indispensable in the nourishment of the young animal.

Or take the case of a joint of meat: suppose we could artificially produce the albumen, the fibrine, the gelatinous matter, the fats, &c., our task would be only beginning. If we present the fibrine in dense masses, instead of in the fibrous state from which it derives its name, and in which it always appears in the flesh of animals, we should have a very indigestible matter to deal with. And how to make it assume this fibrous structure without the aid of the processes present in the living animal is a question of a totally different order, from its mere synthesis as a chemical compound.

So, again, with cotton. Cotton, we find, when pure, is simply cellulose. But the converse does not hold good; cellulose is not necessarily cotton. Before it can become such it must be made to assume the form of very complex fibres.

Natural products of the second class may therefore be considered for the present, and doubtless for a long time to come, quite safe from the competition of artificial substitutes.

Not so those of the first class. There is at present a rage for effecting what are called "organic syntheses." This term is somewhat incorrect, since the bodies obtained are for the most part produced not from their elements, but from the residues of organic matter. Be this as it may, it is certain that not a few chemists of consummate ability direct all their attention to the artificial production of organic bodies. It is a somewhat curious coincidence that the chemical laboratory of the University of Munich, which in the days of Liebig was the centre of earnest and successful efforts for the improvement of agriculture, should now, under Prof. Baeyer, have become the focus of a war against agriculture.

The motives for these endeavours are not far to seek. If a chemist can produce any substance artificially, it is no doubt a confirmation of his theoretical views on its constitution. But we must notice that these attempts are made almost exclusively upon substances which possess a considerable commercial value. Hence the inference is suggested that the object in view is not so much the advancement of Science as the acquisition of gain.

Another motive is the economic heresy of protectionism. In almost all civilised countries the opinion seems to be gaining ground that it is better to produce everything which is needed at home, even if at much greater cost, rather than import it from abroad.

Lastly, the endeavour to obtain some given product artificially, or at least from novel sources, may be made with the intention, avowed or tacit, of injuring the country whence the supply was formerly drawn.

I will now give a few instances of the manner in which this movement has been carried on. My first case is one where an article extensively used in human food has been produced not artificially, but from a totally novel source. I refer to sugar, which up to the earlier part of the present century was obtained exclusively from the sugar-cane, and was of course imported into Europe from the Antilles, South America, India, &c. Unfortunately — I use the word advisedly—the observation was made that the beet-root contained a kind of sugar apparently identical in its chemical and physical properties with that of the cane. This observation might have remained dormant, but the first Napoleon, being then engaged in a desperate war with England, and having vainly endeavoured to attack our sugar-growing provinces (or "colonies" as they are still called), took the matter up. To his far-seeing mind it was at once clear that beet-root sugar might be used as a weapon against this country. No great success was achieved at first, but the idea was not abandoned at the fall of the first French empire. On the contrary, it was taken up in Belgium, Germany, Austria, and Russia; and by dint of great perseverance, a wonderful amount of skill,—both chemical and mechanical,—and lastly, though not least, by duties on the importation of colonial sugar, and by bounties on the exportation of the beet-root product, it has become a formidable rival to the true sugar. What would have been the case in an open market, especially if the same amount of scientific skill were applied to the cane as to the beet-root, may, however, still be doubted.

Beet-root sugar, when refined,—in other words, when freed from extraneous matter,—is, as I have before intimated, generally considered not merely equal to, but identical with, cane-sugar. Latterly, however, doubts are springing up. Some persons, possessing a very delicate organ of taste, profess that they can distinguish the two, and hive-bees are said to refuse beet-sugar if cane-sugar is within reach. One thing is certain: the beet-sugar has done very serious injury to certain important British colonies, to the trade between them and the home kingdoms, and to the sugar-refiners of England and Scotland.

But cane-sugar, whether obtained from the cane or the beet, finds a formidable rival in glucose, a lower kind of sugar produced by the action of sulphuric acid upon starches, and especially upon those of maize and of the potato. Glucose, it must be remarked, is not chemically identical with true sugar; it has a lower sweetening power, and fortunately so far it refuses to crystallise, so that it cannot be introduced into lump sugar, or into the beautiful crystalline product once made by Finzel. But it is largely used in some parts of the world in the adulteration of soft sugars and honey, in the manufacture of jams, of various sweetmeats, and of wines. Now glucose as it occurs in Nature, though less sweet than cane-sugar, is a perfectly wholesome substance. Not so the artificial glucose made from the potato. It contains certain products which on fermentation yield amylic alcohol—the notorious "fusel" oil. Hence wines, spirits, cordials, &c., obtained from the fermentation of such glucose are decidedly unwholesome. Even in the unfermented state it is to be viewed with suspicion, as articles of food sweetened with it are very apt to occasion symptoms of indigestion.

Glucose must, in short, be regarded not as an artificial sugar, but as an adulterant, and it is to be regretted that it is permitted to be sold under such deceptive names as "new process sugar." There is great reason to fear that the manufacture of glucose will be an injury both to the consumers and the producers of sugar.

There are a series of chemical compounds which, some thirty years ago, were introduced into commerce with great flourish of trumpets, and which are still largely used in flavouring confectionery, beverages, &c. I refer to certain compound ethers which simulate the taste and smell of the pear, the apple, the pine-apple, the raspberry, the melon, the quince, &c. That these ethers are really present in the fruits in question is not proven, and there is reason to suspect that —despite their similarity in flavour and odour to the characteristic principles occurring in these fruits—their physiological action is different, and their use of doubtful safety. However this may be, these essences have not affected the cultivation and sale of fruit. That, thanks to their aid, jams are now concocted in America and elsewhere which contain not a particle of fruit, is an unpleasant fact.

The reader will perhaps be surprised to learn that an attempt has been made to obtain artificially coffee and cocoa, or at least their essential principles, caffeine and theobromine. These bodies have actually been produced, though whether at a remunerative price I am not prepared to say. The raw material is xanthine, one of the ingredients of Peruvian guano,—in other words, of the dung of sea-fowl! Even, however, if caffeine and theobromine can be thus obtained as cheaply as in the natural way, it does not follow that coffee and cocoa can be artificially produced in their entirety from this somewhat repulsive source.

Vanilla ranks among the tropical products endangered. Several processes for its formation have been devised. By one of these it is elaborated from coniferine,—a semi-fluid matter found beneath the bark of pine trees,—whilst in another the essential oil of cloves is the starting-point. The actual production of this aromatic principle, so as to be every way identical with the natural growth, is beyond all dispute. But it may still be questioned whether the project is commercially successful, since the cultivation of the vanilla plant in Trinidad, Mauritius, the Seychelles, &c., is in a very flourishing condition, and the planters are reaping a most satisfactory profit.

Turning from dainties to medicines, we find that most persevering attempts have been made at the artificial production of quinine. It is almost a trite saying that Mr. Perkin was seeking to form this drug when he came upon the original aniline-violet. Tidings have lately come that Prof. E. Maumené, a very eminent French chemist, has actually succeeded in obtaining quinine artificially, and at a very small outlay in labour, plant, and materials. Danger threatens the cinchona planter from another quarter. Chinoline, a coal-tar product, is said to have the same medicinal properties as quinine, but it is unstable, and must be used within a short time after its preparation. We shall soon learn what amount of reality there is in these rumours.

We pass to dye-wares,—the region where the war against agriculture has been most signally successful. I refer, as will be at once understood, to the introduction of artificial alizarine and anthrapurpurine in place of the madder-root and its various preparations, such as garancine, garanceux, azale, pincoffine, fleur de garance, &c. Here, however, it must be borne in mind that the triumph of the artificial compounds took place under exceptionally favourable circumstances, such as may perhaps never occur in any other case. The proportion of desirable colouring-matter in madder-root is very small (say 1½ per cent), and even of that amount a considerable percentage was left in the root, and often wasted. It was also accompanied by a disagreeable fawn-coloured principle, which attached itself more or less to the dyed or printed goods, and had to be removed—a process requiring much trouble and nicety. The artificial alizarine and purpurine were therefore at once adopted by the trade.

A prolonged and serious attack is being made upon indigo by Prof. Baeyer. There can be no doubt that he has succeeded in forming indigo-blue, the colouring-matter of indigo. But so far at least he has failed to produce it at a price low enough to compete with the natural article.

But indigo has found rivals in certain artificial colouring-matters, which, without claiming to be identical with it, can under many circumstances be used for the same purposes. I may mention especially the indophenols and the indulines. Hence there is good reason to fear that the indigo trade may have seen its best days. There are, however, certain consolatory points; the growth of the indigo-plant and the extraction of the colour are both capable of great improvement. It is not impossible that by care the value of the crops might be raised 25 to 30 per cent above their present average.

As an instance that factitious products do not always succeed in underselling and displacing the natural growth, I may mention the artificial orchil of MM. Vogt and

Henninger. The colour obtained is identical with that extracted from orchella weeds, but the result is more expensive, and the invention consequently remains a dead letter.

I have thus given not a catalogue, but merely a few instances of the attempts made to displace some natural products by artificial compounds. It may afford matter for thought to our statesmen, economists, and men of business, if they note that nearly all these cases are attacks upon British commerce. In face of such a movement it is surely our duty to derive all the practical benefit we can from the teachings of Science, and, by increasing the yield and improving the quality of our colonial productions, render it less easy for them to be superseded.

III. CRUELTY TO ANIMALS.

By W. Mattieu Williams.

THE letter of Mrs. Kingsford, M.D., on the above subject, in the April number of the "Journal of Science," supplies a curious example of the self-stultification of mere sentimentalism. It is evident, by the coupling of her vegetarianism with her total abstinence from "feather and fur wearing," that in her case the abstinence from pork, beef, and mutton is supposed to be an act of benevolence towards pigs, oxen, and sheep.

Suppose we were all to follow the vegetarian example, how would it affect these animals? The answer is evident enough. It would bring about their extermination, unless we preserved a specimen or two in the Zoological Gardens.

As it is, our carnivorous proceedings are most beneficent in reference to animal life. There are no creatures on the face of the earth who, from a merely animal point of view, lead so enviable a life as those which constitute our flocks and herds, and our domestic poultry. They are provided with food and lodging of the very best kind they are capable of enjoying; the best efforts of Science are devoted to the selection of their food, and prizes are given to those who are the most successful in pampering them. They are supplied with human servants, who tend them with the greatest care, who drive away their natural enemies (flies and maggots included), who watch the state of their health, nurse them when ill, supply them with medicine, attend at their accouchments when necessary, and do everything possible for their general welfare.

In all this world of ours there is no other set of animals enjoying so much animal happiness as these, and yet the sentimental vegetarians cruelly advocate the extinction of all this pastoral bliss that has been a leading theme to poets of all ages.

But Mrs. Kingsford will perhaps reply that we undo and reverse all this by killing them at last. If we are to be denounced for giving life and happiness to each individual for a limited period only, then must these vegetarians similarly denounce the Creator of ourselves and all the rest of the animal world for giving us life, and at the same time making death one of its necessary conditions.

The vegetarian who bases his system of diet on pure and unaffected selfishness, without any goody-goody pretences, may be perfectly consistent in believing that it is better to prepare the organic compounds of vegetables by the aid of scientific cooking than by passing them through the digestive and assimilating organs of animals. He has within reach physiological arguments that are not easily refuted, especially in a warm climate, and he may fairly add to these the natural instinct or sentiment that regards the carcase of a red-blooded animal as a very repulsive object; but from the humanitarian point of view he is far more cruel than the flesh-eater, not only for the reasons above stated, but on account of the number of individual animals he slaughters, if such killing is to be regarded as cruelty; for the boiling of a cabbage involves the immolation of innocent slugs and caterpillars, and tens or hundreds of thousands of Aphides are sacrificed in topping a row of broad beans, to say nothing of the millions of Colorado beetles that have been mercilessly murdered in order that ruthless selfish man may satisfy his greed for potatoes.

If the scheme of Creation were based on the principle of sacrificing the higher animals for the benefit of the lower, and the race for the individual, the anti-vivisection sentimental and vegetarian sisterhood would be in harmony with Nature; but as it is, they should open their meetings not with prayer and praises, but with denunciations of the Omnipotent who has constructed this world and all its inhabitants on a principle diametrically opposed to their superior ideal. They should revert to the ancient idolatries which worshipped bulls and snakes and beetles, in temples erected to their honour.

IV. ON THE APPLICATION OF SOLAR PHYSICS.

By A. H. Swinton.

BARON VON HUMBOLDT complained of Sir John Herschel that, as usual, that distinguished astronomer had pursued his investigations independently of others; and the retort of the British press has been—What a pity it was that the distinguished Baron should have spent so many years in the prime of life working up his travels and researches. We may draw, I think, from this the conclusion that the happy mean, as regards philosophical research will be found to lie between the two aphorisms—original investigation means progress, but original investigation is enhanced in its value when it is referred to its place in the archives of the past. I propose at the present time, then, to take a somewhat wider glance over the domain of Solar Physics, and at the same time to discuss a much-vexed topic that lies at the root of the inquiry. With the assistance of a ready reference to be found in a pamphlet entitled "Ueber die Beziehungen der Sonnenflecken-periode zu Meteorologischen Erscheinungen," von D. F. G. Hahn, and an article on Sun-Spots and Famines, by Messrs. Norman Lockyer and J. Hunter, contained in the "Nineteenth Century" for 1877, I was lately enabled to systematically turn over a very considerable portion of the recent sun-spot literature that has taken shape of late years in the "Philosophical Transactions," "Nature," the "Memoirs of the Royal Astronomical Society," and some few of the meteorological journals. I likewise found that more papers were to be had in "Silliman's Journal," and other American publications. As regards Germany, I was referred to the "Berichte der Königlich Sächsischen Gesellschaft, der Wissenschaft"; and as regards Switzerland, to the "Astronomische Mittheilungen," and other publications emanating from Zurich. Then as regards Austria, there was the "Zeitschrift der österreichischen Gesellschaft für Meteorologie," the "Denkschrift der Wiener Academie," and other works; as regards France, the "Comptes Rendus"; and as regards Belgium, the "Mémoires de l'Académie Royale de Bruxelles."

It however requires, I think, but a cursory glance over these endless papers, to show that the tabulation of sun-spot phenomena has at length taken a certain definite shape, and that the chief results are already known. But what is not a little curious, it will at the same time be discovered that certain outstanding questions have arisen out of the enquiry where a difference of opinion is expressed. Take, for example, the question—Is the sun hottest when it has fewest or most spots on its face? This looks simple, and yet some argue one way and some the other. Are the spots a defect in the photosphere, or are they the indications of a period of solar energy? Experiments with the black bulb thermometer, between the years 1837 and 1869, brought Prof. Piazzi Smyth to the conclusion that at Edinburgh a great heat-wave occurs every eleven years and a fraction, its maximum slightly lagging behind the minimum of the sun-spot cycle. Mr. E. J. Stone, at the Cape of Good Hope, from the temperature observations recorded during thirty years, came to a similar conclusion; and Dr. W. Köppen, in his elaborate paper, finds that in the tropics the maximum of warmth occurs a full year before the year of minimum sun-spots, while in zones beyond the tropics it falls two years after the minimum. This would incline us to the opinion that the period of fewest sun-spots is the warmer of the two, which is certainly the impression on the writer's mind; but let us look to the physical side of the question.

The heading of the physical enquiries from which opinions on the subject may be drawn are, of course, the winds and rains, the seasons and agriculture, and the magnetic and seismic phenomena. First, the winds and rains: these, as is generally admitted, come on at the period of most sun-spots; 1879 is an example of a disastrous and wet season occurring at such a period. Some say wind and rain mean that the sun has then greater energy; but it must be added that this does not so clearly make out a case of greater heat, since cold is likewise an essential to locally condense the atmosphere, and so to raise the wind and saturate the air. We may illustrate this point by remarking that wind and rain are characteristic of the colder, and not the warmer, portion of the year. Then magnetic disturbances likewise occur at the period of most sun-spots; but here, again, I am not aware that there is any proof to show that these disturbances are the result of a thermal storage of electricity at this time. From Dr. R. Capron's work on the "Auroræ and their Spectra" we learn that these disturbances, which are of the same nature as thunderstorms, occur mostly in March and October; that their curves of greater frequency tend towards the region of atmospheric pressure, and that they bear the same relation to the limit of perpetual ice. This, as I take it, refers their causation, like the wind and rain, to a differentiation in the temperature. As regards the seismic disturbances, earthquakes quiver and volcanoes are active at two points in the sun cycles. They break out when the sun-star has fewest, and again when it has most, spots on its photosphere. This remarkable truth, as far as I can learn, was first enunciated in its entirety by Dr. Fuchs, in his pamphlet "Die Vulkanischen Erscheinungen der Erde," published in 1865; but some thirteen years earlier we find it related, in the publication of the "Naturforscher Gesellschaft" of Bern, that a discussion had arisen between Prof. Wolf and M. E. Kluge as to whether it was a fact that the Auroræ Boreales and earth tremors accumulated during the years when the sun-spots were most prevalent and the magnetic variations were most remarkable. Still if anyone will take the trouble to tabulate the eruptions of Etna and Vesuvius,—say between 1755 and the present time,—I think the only wonderment that will arise in his mind will be, How is it that this matter was not found out long before? It is ages since old mother Etna was discovered to be the poor man's weather-glass. Sir John Maunderville, that most susceptible and credulous historian of the East, relates—"Also in that isle, Sicily, is Mount Etna, which men call Mount Gybell, and volcanoes that are ever burning. And there are seven places which burn and cast out flames of diverse colours; and by the changing of those flames, men of that country know when it will be dearth or good time, or cold or hot, or moist or dry, or in all other manners how the time will vary." But do the earthquakes and eruptions inform us whether the sun is colder or warmer when it is most spotted? Allowing these may be due to the thermal expansion and contraction of the earth's crust producing lateral thrust, it would not appear that any positive data are possible, unless it can be certainly stated when the earth's surface is most expanded and when it is most contracted. The eruption of volcanoes and the earthquakes might result from excessive expansion or extreme contraction, since the lowering or raising of the soil would alike open a vertical orifice.*

Then as regards the seasons and their passing features, Dr. Hahn has constructed a table of mean temperature, from which it would appear that the cold summers and winters follow the maximum of sun-spots, and the warm summers and winters the minimum; and, according to his view, it is the warmth and dryness of the interval between the minimum and maximum period that accounts for the appearance at this conjuncture of locusts in Europe. As to this last assertion, however, I think some latitude must be allowed, as at times stray locusts arrive at the shores of the United Kingdom a few years previous to the minimum epoch; nor is it very evident, from Dr. Hahn's temperature table, that the warm years that arrive at the epoch of fewest sun-spots last until the succeeding maximum. So then, as before, the temperature observations associate the warm summers with the minimum of sun-spots, and it is an old adage that it is the warm years which bring the locusts. It is, however, somewhat satisfactory to learn that the periods of multiplication of certain insects more disastrous to our home-produce than locusts do not coincide here in point of time. By referring the species to the orders to which they belong, I think we may gain from tabulation that crane-flies (Tipulidæ) have multiplied in this country at the maximum epochs, destructive moths (Noctuidæ at the same period; and that, on the other hand, corn weevils (Rhynchophora), and perchance certain saw-flies (Tenthredinidæ), have multiplied at the minimum epochs.

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* When writing my last paper on Solar Physics ("Journal of Science" for March, 1882) it had escaped me that Prof. Wolf had already given an approximation of the sun-spot cycles carried back to 1610, from certain records extant: they differ but in few instances from those I have calculated. I also should have said (page 158) that the cycles lengthen in all appearance at the end of the sixteenth and eighteenth centuries, and are short about 1640: there are certain long periods associated.

V. DEATH NOT UNIVERSAL.

IT may seem at first glance remarkable that a phenomenon so superabundantly dealt with as Death has been, by orators, novelists, poets, and divines, should yet be so much misunderstood. A friend of ours, indeed, suggests that this misunderstanding is the natural consequence of the treatment the subject has received from the classes above mentioned. If the British public would condescend to take its notions of death from the sober teachings of physicians and naturalists it would both learn and unlearn no little.

The first error which we must point out is the popular antithesis between death and life. Such antitheses, as it has been from time to time shown in the "Journal of Science," are at best of doubtful value, being as a rule founded in men's conceptions or misconceptions, rather than in the nature of the things compared. Life may, indeed, be logically contrasted with a state prior to its own commencement or—on the monistic hypothesis—subsequent to its conclusion. But how it can be profitably and logically compared with its own termination is not easily seen. Draw a finite straight line: what contrast exists between such line and the point where it ends? No; if we want something fairly antithetical to death—*i.e.*, to the conclusion of life—we must find it in the beginning of life, that is in birth. Where there is no birth there can be no death. This consideration we shall presently find is not unimportant.

Another notion deeply rooted in the popular mind, and in ordinary literature, is that death is common and necessary to all organic beings. Whatever lives, we hear it said, whether plant or animal, must sooner or later die. It will therefore greatly shock many persons to learn that this is not strictly the case. We wish here to give room for no misunderstanding, and, if possible, for no intentional misinterpretation. All animals *may* die, but death is not in all departments of the animal kingdom an inherent absolute necessity. On the contrary, in one of the two primary divisons of the animal world, the Protozoa, it is, though common enough, merely casual, the result of some accident. A Protozoon may be swallowed up by some larger animal; it may be crushed out of existence, burnt, or poisoned by "disinfectants" introduced into the water or other fluid which it inhabits. But it has no natural term of life, and, as we shall presently see, cannot be spoken of as young or old.

That this may be understood we must briefly compare the life-history, and especially the reproduction, of the *Metazoa* and the *Protozoa*. In the former group—which includes all the back-boned animals from man down to the humblest fish, all the insects, mollusks, as well as lower forms of life which scarcely attract popular notice—there is always a distinct difference between parent and offspring. The latter is certainly a portion separated from the body of the parent, —from the female in all those forms in which there exist two sexes,—but it is as compared with the parent minute in size, rudimentary in structure, and it has to increase in bulk, and still more to undergo a process of development, a series of transformations, before it reaches the normal stature and make of its species. When this point has been attained it enters upon the task of reproduction, and gives birth to one brood of young ones, or in the higher forms to several. With these it co-exists for a longer or shorter time, and then dies, the matter which constituted its body passing into decomposition. If we look at these very familiar facts in the life of a Metazoon, be it a man or an oyster, we find that the ideas of birth, of growth, of maturity, of parenthood, of a natural term of life ending in death, at once suggest themselves. If we examine such a Metazoon we can, in most cases, at once decide whether it is in the immature or the adult phase of its being.

But in the *Protozoa*—as Herr Bütschli has not long ago pointed out in the "Zoologischer Anzeiger"—this is distinctly different.

Let us suppose we are watching through a microscope one of these minute single-cell creatures. We see it expanding into an ellipsoidal figure, which becomes for a time longer and longer. It then begins to contract about what we may, for the sake of popular intelligibility, call its equator. It assumes the form of two nearly globular bodies, connected, dumb-bell like, by a narrow neck. This neck becomes narrower and narrower, and at last the two globes are set free, and appear as two individuals in place of one! What are the relations of these two new beings to the antecedent form and to each other? We examine them with care; they are equal in size, alike in complexity, or rather simplicity, of structure. We cannot say that either of them is more mature or more rudimentary than the other. We can find in their separation from each other no analogy to the separation of the young animal or the egg from its mother, or to the liberation of a seed from a plant. Neither of them is parent, and neither offspring. Neither of them is older or younger than the other.

Or shall we try to regard them as brothers, sprung from the same parent? If so, where is that parent? If living, let it be shown; if dead, where are its remains? No organic —or indeed any other—matter was separated out when the two new beings took their rise. All the substance of the body of the original Protozoon is included, and equally included, in the bodies of the two individuals before us. Thus we see that the essential ideas of the life of the higher animals—birth, growth, maturity, parentage, brotherhood, term of life, and successive generations—have, if applied to these humble and minute beings, simply no meaning.

The process of reproduction, or rather of multiplication, must, as far as we can see, be repeated in the same manner for ever. Accidents excepted, they are immortal; and frequent as such accidents must be, the individuals whom they strike might, or rather would, like the rest of their community, have gone on living and splitting themselves up for ever. It is strange, when examining certain Infusoria under the microscope, to consider that these frail and tiny beings were living, not potentially in their ancestors, but really in their own persons, perhaps in the Laurentian epoch!

This consideration opens up another question. These beings are not wholly unconscious. They experience and retain impressions, however dimly and in however limited a sphere. But when the splitting up one individual into two distinct personalities takes place as we have described above, we have then the curious phenomenon of two distinct and equal beings whose past life is one, who will remember the same incidents and the same reactions to which such incidents have given rise. Here again is a phenomenon which we cannot realise,—two contemporary and coequal beings possessing, up to a certain point at least, a common psychic life. Let us for a moment suppose that the propagation of the higher animals took place in a similar manner. We should see, *e.g.*, the mature man split up into two equal and similar men, each remembering, knowing, believing, and feeling, up to the day of fission, all that the other remembered, knew, believed, or felt; each, too, it might be contended by moralists, equally sharing the merits or demerits of the antecedent form, and each at a loss to say when his own personality took its rise.

VI. OCCULTISM RECONSIDERED.*

WHEN, about a year ago, it became our duty to examine the first edition of Mr. Sinnett's extraordinary work, we did not feel free, like some of our contemporaries, to dismiss the author and his subject with a contempt scarcely kept within the bounds of ordinary courtesy. On the contrary, we should have been glad—too glad—if we could have laid our finger upon some proposition and proclaimed it demonstrable truth, how fully soever it might clash with the orthodoxies of Science. Our search was unrewarded, and we closed the book with a deep feeling of disappointment. We were not sorry, however, on the appearance of this second edition, to re-open the question, and, as far as possible, to attempt to present the views of the Occultists in a systematised form, and exhibit their apparent relation to the Philosophy and the Science of the modern world. That our success in this attempt will be but very imperfect we foresee. We never met with a book in which definite, tangible, verifiable statements were so purposely and skilfully avoided.

Like the author, we will begin with noting the relations of Occultism to Spiritualism. The two are not, as is commonly supposed, identical.

Mr. Sinnett makes, indeed, the significant remark that it is not his " present task to make war on Spiritualism." He remarks that the announcements he has to make " will be probably received more readily among Spiritualists than in the outer circles of the ordinary world." He admits the facts of Spiritualism, but he contends that its phenomena are manifestations which mediums can neither control nor understand, whilst occult phenomena are achievements of a conscious living operator comprehending the laws with which he works. If such achievements appear miraculous, that is the fault of the observer's ignorance. The Spiritualist, it is asserted, is very reluctant to tolerate the production of a new hypothesis which will compel him to reconstruct his views almost from the beginning.

We turn to the relations of Occultism to Modern Science, or, as we prefer to call it, Open Science. These relations are not too clearly expressed, and apparently not too amicable. We read (p. 1) that "modern metaphysics, and to a large extent modern physical science, have been groping for centuries blindly after knowledge which occult philosophy has enjoyed in full measure all the while." The author tells us that he has come in contact with persons who are heirs of a greater knowledge concerning the mysteries of Nature and humanity than modern culture has yet evolved." He admits, indeed, that "modern science has accomplished grand results by the open method of investigation. Yet he tells us that secluded Orientals may understand more about electricity than Faraday, more about physics than Tyndall," and that "adepts of occultism are capable of exhibiting results that prove them immeasurably further advanced than ordinary modern science in a comprehension of the forces of Nature," though all the time "physical science has merely been an object for occultism of secondary importance." These assertions of the superiority of Oriental Science may be in accordance with facts or they may not, the data for a decision being wanting. But in order to show the manner in which our ordinary open science is judged in the work before us, the reader must be introduced to an adept of high rank in the Occult Brotherhood—Koot Hoomi Lal Singh. This gentleman is apparently a Sikh by birth. In his youth he was sent to Europe "to be educated in Western knowledge, and since then has been fully initiated in the greater knowledge of the East." Several of his letters are given in full, and their contents seem to be endorsed by Mr. Sinnett as the authoritative teachings of Occultism. Among the first points which strike us are certain plain misconceptions as regards the history and the teachings of open science, which come with scant grace in a treatise where such science is spoken of with undisguised contempt. Thus we read (p. 96),—"Experimental knowledge does not quite date from 1662, when Bacon, Robert Boyle, and the Bishop of Chester transformed, under the royal charter, their 'invisible college' into a society for the promotion of experimental science." Surely it is well known that Bacon was dead prior not only to the incorporation of the Royal Society in 1663, but even to its private formation in 1645. What is of much more importance, no one in Europe supposes that experimental open science took its rise at so recent a date. Without referring to the comparatively modern researches of Torricelli, Gilbert, and others, we may point to the Book of the Balance of Wisdom, which shows that in the twelfth century the Arabian philosophers investigated Nature just as we do, by experiment and observation, and published their discoveries in plain language. The same may be said of the true Greek philosophers, such as Thales, Empedocles, Democritus. Going still farther back, we find an Egyptian medical treatise, the "Papyrus Ebers" (of the date 1552 B.C.), clear and open in its teachings, and written in a manner which shows that the observation of natural phenomena and committal of experience to writing—as we should now say, publication—were not things of yesterday. Hence we have proof that, contrary to the dictum of Mr. Sinnett (p. 3), for some 4000 years men of Science did not exclusively work in secret, or teach their discoveries merely "in secret to carefully selected pupils." In fact the burden of proof lies, we should say, with those who maintain that Occult Science is the elder. The culture of Europe has "*not* been developed by Europeans for themselves within the last few hundred years."

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* The Occult World. By A. P. SINNETT. Second Edition. London: Trübner and Co.
Zanoni. By Lord E. BULWER LYTTON.
A Strange Story. By Lord E. BULWER LYTTON.

But not merely is the history of open science apparently misunderstood, its present views and its future aims are not fairly set forth. Thus in a letter of Koot Hoomi Lal Singh's (p. 97) he is made to say—"The very existence of those gigantic ancestors of ours is now questioned,—though in the Himavats, on the very territory belonging to you, we have a cave full of the skeletons of these giants, and their huge frames, *when found*, are invariably regarded as isolated freaks of Nature." Now if there is one error of the past more completely and unanimously rejected by Modern Science than another, it is that of regarding fossils as *lusus Naturæ*. We call attention to the words we have italicised, which seem to imply that such skeletons have been found. By whom? Had they fallen into the hands of the Geological Survey of India the whole world would have been aware of every particular.

Again, we are told on p. 132—also by Koot Hoomi Lal Singh—that "the philosophical and transcendental notion of the mediæval Theosophists, that the final progress of human labour, aided by the incessant discoveries of man, must one day culminate in a process which shall result in the evolution of nutritious food out of inorganic matter, is unthinkable for men of Science." A more mistaken accusation was never brought forward. The great object of modern chemists is the evolution of organic compounds—commonly so-called—out of inorganic matter, and the many striking successes which they have achieved in the last few years merely urge them on to further attempts. The synthesis of human food may not be effected this century or the next, but it is kept fully and clearly in view as the great goal of applied science.

Hence we submit we have shown that the history, the teachings, and the aims of open science do not receive full justice at the hands of Mr. Sinnett.

We may now cast a glance at certain important and fundamental distinctions between Occultism and Open Science. Koot Hoomi Lal Singh is quoted as saying—"You do not seem to realise the tremendous difficulties in the way of imparting even the rudiments of our science to those who have been trained in the familiar methods of yours. The more you have of the one the less capable you are of instinctively comprehending the other." Open Science, as we know, is purely intellectual. It is attained by intellectual training only, other pursuits—whether in themselves morally good or evil—being discarded as distractions. In the book before us Koot Hoomi complains of modern civilisation as resting so exclusively upon intellect. He complains, even, that "exact experimental science has nothing to do with morality, virtue, philanthropy." He asks, censuring, "What have the laws of Faraday, Tyndall, or others to do with philanthropy?" The training of the adept is not purely intellectual, but seems to involve a certain amount of asceticism. There is required amongst other things "a life of absolute physical purity"—whatever these words and their subsequent explanation may mean. The type of the adept here given is thus widely different from Lord Lytton's Mejnour. He, if an ascetic, was so like not a few of our modern men of Science, simply from complete absorption in his studies. He is described not as a philanthropist, but as purely intellectual in his pursuits. With him life "is but a power to examine."

Passing to the tenets of Occultism as compared with those of Open Science, we find, in the former as in the latter, the recognition of the immutability of law, and of the principle of continuity. Evolution seems to be admitted, and perhaps even abiogenesis, since the object of Nature is proclaimed to be (p. 129) "the evolution of conscious life out of inert material." The age of miracles is declared not to be past, but never to have existed. Concerning energy a remarkable difference of views must be noted. Says Koot Hoomi:—"You see no difference between the energy expended by the traveller who pushes aside the bush that obstructs his path and the scientific experimenter who expends an equal amount of energy in setting a pendulum in motion. We do; for we know there is a world of difference between the two. The one uselessly dissipates and scatters force; the other concentrates and stores it. And here please understand that I do not refer to the relative utility of the two, as one might imagine, but only to the fact that in the one case there is but brute force, flung out without any transmutation of that brute energy into the higher potential form of spiritual dynamics, and in the other there is just that." We must frankly own our entire inability to attach any meaning to these words, or to conceive the possibility of the motives of an action having any influence upon its physical conditions. In a similar strain Koot Hoomi continues:—"Still less does exact Science perceive that while the building ant, the busy bee, the nidifacient bird, accumulates each in its own humble way as much cosmic energy as a Haydn, a Plato (!), or a ploughman turning his furrow in theirs; the hunter who kills game for his pleasure or profit, or the positivist who applies his intellect to proving that + × + = −, are wasting and scattering energy no less than the tiger which springs upon its prey. They all rob Nature instead of enriching her, and will all in the degree of their intelligence find themselves accountable." Perhaps Koot Hoomi here forgets two things—that the "positivist" has small respect for a life of scientific research, and places the solving of equations upon a par with the pointing of pins; and secondly, that the "building ant" is size for size a greater destroyer than the tiger.

Again:—"Heat is but a mode of motion to her (*i.e.*, to Science), and motion develops heat, but why the mechanical motion of the revolving wheel should be metaphysically of a higher value than the heat into which it is gradually transformed she has yet to learn."

A prominent part is played in Occult lore by a mode of energy, if we may so call it, named *akas*. This, the author says, "is a force for which we have no name, and in reference to which we have no experience to guide us to a conception of its nature. One can only grasp at the idea required by conceiving that it is as much more potent, subtle, and extraordinary an agent than electricity, as electricity is superior in subtlety and variegated efficiency to steam,"—a description which, we submit, throws not a ray of light upon its nature and properties. There is not even a reference to any natural phenomenon in which this unknown form of energy plays a part. We are merely told that by its means the adept can transport material objects to any distance, disintegrating them, conveying the particles through the air or through solid bodies, and again re-uniting them into their original form! Certain phenomena brought forward in this book as evidence of the reality of Occultism, and of the powers of its votaries, appear to turn upon a display of this force.

Passing from Physics to Psychology, we find the so-called Materialist view rejected with some emphasis. Man is regarded as a threefold being, composed of body, soul, and spirit. We may here remark that on this subject some variety of opinion prevails. The ordinary hypothesis—as held by all the orthodox religious bodies and by many metaphysicians—views him as consisting of two principles only, body and soul or spirit, the two latter being regarded as synonyms for an immaterial entity. On the other hand, certain mystics and mænads seem to regard man as a fourfold being. The soul, according to Mr. Sinnett and his guides, is, however, not spiritual, but material.

(To be continued.)

VII. ON TECHNICAL EDUCATION.

By Robert Galloway, M.R.I.A.

(Continued from page 290.)

ENGLAND, it has been stated, with a great deal of truth, is the country of "*Cries and Catchwords.*" This national peculiarity is owing no doubt in a great measure to the public life of the country being carried on by means of parties. "A liberal education" is a very favourite catchword at the present time, but for one person who uses the phrase intelligently a thousand at least, it is to be feared, use it unintelligently. "Technical education" and "Payment by results" are also popular cries; yet of the number who are admirers of the system of payment by results for teachers, how many out of the number have ever seriously tried to ascertain whether the system has proved a success? It is to be feared that in this case also the majority make use of the phrase simply as a cry, never investigating, or attempting to investigate, whether the system has worked well for the advancement of scientific and technical education in the kingdom.

One great obstruction to the establishment of schools suitable for the middle class—and without such schools our technical colleges will avail us little in improving and extending our manufacturing industries—is owing to the English people confining the meaning of the term "a liberal education" solely to a classical education. A classical education was no doubt the best that could be framed in earlier times, and it is probably the one most "suitable for the higher classes in the present day," but boys who are intended for a manufacturing or a commercial life require to be taught subjects that will train their mental powers as—if not more—perfectly, and will enable them to discharge their duties in after life more efficiently.

English people have not realised, like other peoples have done, that a different education is required by the different classes,—that the system of school education to be adopted ought to be determined by the wants of the particular class to be educated; hence England lags behind other civilised countries in educational progress. *We continue* to dress our children's minds as we do their bodies, in the prevailing fashion; and a classical education is the fashionable education, because it is the education the higher classes receive. "If we inquire," Mr. Herbert Spencer states, "what is the real motive for giving boys a classical education, we find it to be simply conformity to public opinion. We are guilty," he states, "of something like a platitude when we say that, throughout his after career, a boy, in nine cases out of ten, applies his Latin and Greek to no practical purposes. The remark is trite that in his shop or his office, in managing his estate or his family, in playing his part as director of a bank or a railway, he is very little aided by this knowledge he took so many years to acquire—so little that generally the greater part of it drops out of his memory; and if he occasionally vents a Latin quotation, or alludes to some Greek myth, it is less to throw light on the topic in hand than for the sake of effect."

The merchant, the trader, the producer, the constructor, and the inventor, have always in the past found knowledge to be power; and in the present day it is a still more important factor for success in buying and selling, in manufacturing and constructing, and in inventing, in consequence of competition being so much keener, not only between individuals belonging to the same nation, but between competitors of different nations, the markets also being more numerous and larger, and present improvements in manufacturing industries being the outcome of higher scientific knowledge than those in the past required for their successful carrying out far more scientific skill than the older and cruder ones did; and the requirements and tastes of the people of all countries are ever increasing and ever changing, and therefore the manufacturer who would be successful in the present day must be constantly anticipating the wants of the public by new inventions.

Although England has contributed a goodly number of those educational reformers who have from time to time appeared with new and improved methods for teaching the very young, no one has yet come forward in this country with a good system of school education suitable for boys intended for commercial and manufacturing pursuits. The reason no doubt is due, in a great measure, to the fact that all the chief appointments in our grammar and other public schools have been occupied exclusively by clergymen whose education, both at school and the university, has been that based on the requirements of the Middle Ages. It could not be expected that there would arise from this class of teachers a reformer who would strike out a course of study for youths that would fit them best for their future employments in commerce or manufactures; and as they exclusively occupied the chief scholastic situations, and imposed on the country the system of school education adopted, they prevented laymen from taking part in educational reforms. It is true that many of our scientific men have given evidence before Commissions, and addressed the public—either on the platform or through the press—on the necessity of introducing one or more of the Inductive Sciences into the course of school studies, but I am not aware that any of them has yet propounded a complete course of studies for boys of the middle class. Nay, they have not even discussed the best methods of teaching the induction sciences in schools, but have been contented to continue antiquated methods or accept newer ones at second-hand. Although boys intended for manufacturing pursuits ought to lay the foundation-stone of knowledge of one or more of the inductive sciences at school, there are other subjects more important than the inductive sciences which boys intended for trade and commerce ought to be taught.

Instead of establishing, as other countries have done, schools in which the course of instruction given is suitable for the wants of the middle class, we are trying to combine both systems of education—the old and the new—in the same institution : this will at least prove less successful than the one other countries have adopted. Mr. Matthew Arnold observes, in reference to this subject, in his French Eton,—"On the Continent of Europe a clean sweep has in general been made to the old form of scholastic establishment, and new institutions have arisen upon its ruins. In England we have kept our great school and college foundations, introducing into their system what correctives and palliatives were absolutely necessary. Long may we keep them ! but no such palliatives or correctives will ever make the public establishment of education which sufficed for earlier ages suffice for this. . . . That is where England is weak, and France, Holland, and Germany are strong."

I have dwelt at some length on the necessity of having suitable schools for the middle class, for this is the first educational requirement for those intended for commerce and manufactures. Without such schools all other plans for promoting and improving technical education in this country will prove inefficient. I know from personal knowledge that many young men are going to our technical colleges who are utterly unprepared to benefit by the instruction given. I met one not long ago, in London, who was attending lectures and a laboratory devoted to brewing. He knew nothing whatever of the language of the science ; and, as language is the nutriment of thought, from not knowing it the atmosphere in which chemical thought lives was wanting. I do not mean to imply that he would not be able to remember isolated facts, but what I assert is that he was not able to reason about them ; he was not able to judge what they proved, and how, through the facts he knew, to get at others which it might be desirable for him to know.

ANALYSES OF BOOKS.

The Scientific Basis of National Progress, including that of Morality. By G. Gore, LL.D., F.R.S. London: Williams and Norgate.

We have here an able and earnest plea for the furtherance of scientific research considered as the essential condition of national progress. The author's leading idea is that present knowledge can merely enable us to maintain our present state, whilst any advance must be derived from new knowledge. Unless new discoveries are made, inventions and improvements must sooner or later cease. This idea, we think, must be in the main accepted. It may indeed be contended that a portion of the knowledge we at present possess is not utilised, and that, even when it has been brought into the tangible form of an improvement or invention, it may still remain for years a dead letter. With us, indeed, the inventor is in a painful dilemma. Let his device be never so clearly demonstrated, the mob of so-called practical men still hold back. If business is brisk—perhaps some of our readers may be able to carry their memories back to such a time—the average John Bull is apt to say that that there is no need of improvement, and that an economy of a few hundreds of pounds or a slight improvement in quality is not worth "bothering" about. On the other hand, when trade is slack no one has the courage to attempt any departure from established routine. Thus it often happens that the greater the essential value of any invention the greater is the difficulty of getting it taken up. We suspect that the nations who are our chief industrial rivals do not take exactly the same view of novelties.

Dr. Gore works out his fundamental idea in four chapters, treating respectively of the scientific basis of material progress; the scientific basis of mental and moral progress; new truth, and its relation to human progress; and, lastly, the promotion of original scientific research. "The chief object of this book," it is stated, "is to disseminate more correct ideas respecting the importance of *new* positive knowledge, and the duties of society in relation to it; and a further object is to assist in maintaining Birmingham in the front rank of intellectual, social, and moral advance!" We cannot read these lines without putting on record our sorrow that, at least as far as one science is concerned, Birmingham should have taken up a retrograde position, and that the trustees of Mason College should already, at the bidding of organised ignorance, have placed fetters upon an Institution opened with such high hopes and promises. We make these remarks the rather because the author estimates the Anti-Vivisection "movement" at its just value, as one of the manifestations of the retarding spirit in our midst.

The following passage should give ample scope for serious reflection:—"When famines result from insufficiency of solar heat, instead of investigating the conditions of the sun's surface, to enable us to predict their occurrence and provide accordingly, we allow them to come upon us in our unprepared state, and produce their fearful effects. When contagious disease overtakes us, what do we do? Instead of previously employing and paying scientific investigators to make experiments in physiological and chemical science, to enable us to combat it successfully, we vainly attempt to apply our present stock of chemical and physiological knowledge to ward off the difficulty. When high price of fuel intervenes, instead of previously giving discoverers the means of finding new principles relating to heat and to chemical and electrical action, we ineffectually endeavour by means of invention to economise fuel. These are the pottering, short-sighted, and ignorant ways in which 'the great English nation' temporises with great evils, and permits national welfare to be sacrificed to private gain." This is an unpleasant, a humiliating picture, but is it not too true?

In one part of his work Dr. Gore gives an interesting specimen list of inventions wanted. To one of these we must take emphatic exception. The author thinks it desirable "to find larger uses for phosphorus." We hold, on the contrary, that the only legitimate use for phosphorus is as plant-food in the state of phosphoric acid, and that its appropriation to other purposes, limited as the supply is, should be checked by heavy penalties.

Dr. Gore contrasts the enormous sums of money expended in this country upon *quasi*-philanthropic movements with the tiny driblets which are forthcoming for scientific research. What are the sums thus disbursed by the Royal Society, the British Association, &c., in comparison with the incomes of the Anti-Vivisection, Anti-Vaccination, and other "anti" organisations? This neglect, our author thinks, is due to the ignorance of the wealthy classes. The following passage from a letter from the Duke of Somerset throws some light upon this widespread ignorance:—

"The hindrances to scientific studies in this country are very many. The gentry are almost invariably educated by the clergy, and the clergy have seldom had time or opportunities for any scientific study. They usually take pupils or become tutors as soon as they have taken their degrees, and can only teach the Latin and Greek which they have themselves learned. The commercial classes value what they call practical science: this means some application of science for the purpose of making money. Competitive examinations may promote a superficial acquaintance with the elements of science, but are unfavourable to the development of scientific culture. The scientific associations tend to degrade science, by exhibiting scientific men as candidates for applause from assemblies which seek amusement and startling results from lectures and experiments. The advancement of science is therefore left to comparatively few men, who are unregarded and unrewarded."

It must be noted that neither the writer himself nor the authorities whom he cites speak of the discouragement to research in England as a feature merely of the past. He and they alike speak of the present, and detect few, very few, signs of any change for the better, South Kensington notwithstanding.

Among the plans suggested for placing research in this country upon a footing as advantageous as it occupies in Germany, the author enumerates—"1st. By founding State laboratories, in which discoverers of established repute, supplied with every aid and appliance, should be wholly engaged in research in their respective subjects, and be paid by the State. 2nd. By founding colleges or Professorships of original research in each of the Universities, and appointing Professors similarly. 3rd. By founding provincial colleges or Professorships of research, the funds being raised locally by means of subscriptions, donations, and endowments, with or without State assistance. 4th. By State or Local aid in the form of additional salary to Professors in colleges, to enable them to pursue research. 5th. By an extension of the present Government grants distributed by the Royal Society. 6th. By making it a condition at each of our Universities that every student entering for a degree in Science should previously make an original research. 7th. By the formation by learned societies of Endowment of Research Funds, and making grants of money therefrom to recognised investigators. 8th. By aid to local investigators by Municipal bodies out of the rates. 9th. The support of Institutes of Research by private munificence." The author remarks, justly enough, that the chief difficulty to be surmounted in carrying out any of these schemes is the very general ignorance in this country of the value and necessity of research.

We can carry our examination of this important work no further. It merits the careful consideration of thoughtful men, as showing that no amount of elementary education—not even the increase in quantity and the improvement in quality of secondary technological training—will suffice. All this is well, but if we wish to lead the world industrially we must keep in advance in original discovery. This object the Germans have pursued now for the last half century, "unhasting, unresting," and the results are making themselves felt. It is still not too late if we will really arouse ourselves, but how long an opportunity will be given us is very doubtful.

Remarks on Certain Medical Principles and Publications. By Dr. Joseph Hamernik, of Prague. Translated from the German by F. Marks. London: F. Marks.

The author of this pamphlet is apparently given to "views." He is an anti-vaccinationist and vegetarian, probably a teetotaller, an opponent of modern sanitary reform—in so far at least as it seeks the cause of epidemics in polluted waters. He is also opposed to blood-letting, to purgatives, to mineral waters, to the parasitic theory of disease, to disinfection, and to the antiseptic method in surgery. Personally he appears to have a strong objection to Prof. Virchow, to Klebs, to Henle, Semmelweiss, and the "medical bureaucracy" in general. In his objections to vaccination—which are possibly the cause why the pamphlet has been translated into English—we find little that can be novel to our readers. He maintains that various diseases, and notably tuberculosis and syphilis, are propagated by means of vaccination; that it affords no protection from smallpox; that during an epidemic vaccinated and unvaccinated are alike attacked, recover, or die, the appearance and conditions of the disease presenting no diversity whatever. He denounces medical statistics and medical logic *in toto*. He writes that "when a few years later [we presume after the introduction of vaccination] smallpox happened to occur less frequently, and in a milder form, the alchemical artists [*sic !*] thought it quite natural that, though only from 5 to 6 per cent of the population was vaccinated, the diminution of smallpox was due to vaccination. Before the great epidemic of 1870-72 the population was vaccinated within about 5 or 6 per cent, large numbers having likewise been vaccinated more than once; and the vaccinators and their adherents were short-sighted or barefaced enough to pretend that the 5 or 6 per cent of the unvaccinated were to blame for the epidemic, and even for the appearance of smallpox at all."

The following *à priori* argument against the possibility of a preventive against smallpox does not throw a very favourable light upon Dr. Hamernik as a reasoner:—"What kind of world-order would that be into which each speculator or impostor could introduce changes in which, for instance, smallpox and anti-smallpox both had place? Would it not be simpler and more natural to omit both?" If the author would look around him he might see the whole world full of conflicting agencies, devised, say the teleologists, to keep each other within bounds, which might have been omitted.

On the liability to take cold Dr. Hamernik writes—"This effeminacy is largely brought about by our artificial and unnatural mode of life, especially by the prevalent custom of eating meat and drinking spirituous liquors." Does the author suppose that, *e.g.*, the Red-skins of North America, the white trappers who have adopted their habits, or the Guachos of the Pampas,—all of them far more carnivorous than the inhabitants of civilised Europe,—are very liable to suffer from chills and draughts? Or the Fuegians, whose diet consists of little other than animal matter, and who yet, according to Darwin, must be unsurpassed in their power of enduring cold and damp? To continue our quotation:—"For the cure of the evil a vegetarian diet is best adapted, also the drinking plenty of spring water, a liberal use of baths, avoidance of beer and of such clothing and house-heating as tend to keep the body uncomfortably hot." We may here remark that, in England at least, clothing and house-heating which render the body "uncomfortably hot" are rare indeed. But the author continues:—"In addition to this, man should follow the example of the lower animals, only washing and bathing in cold water (temperature about 22° or 20° Réaumur), and taking just so much exercise as will gently stimulate without fatiguing the body." Many of the readers of the learned Doctor's pamphlet in its English version may not be aware that this *cold* water is from 81° to 77° F.! How, we ask, are the lower animals in so-called temperate climes to get water so warm as this? In England the average temperature of the streams and pools will not exceed 50° F. Even amongst men, bathing in water at 77° F. is a luxury open only to the few. Again, we should like to know what proportion of mankind in these days can take "just so much exercise as will gently stimulate without fatiguing"? Multitudes are compelled to take very much more, and multitudes who follow sedentary occupations cannot have nearly enough.

At a loss what to say or think of an author who can gravely advise us to follow the example of the lower animals, by bathing in water at 77° F., we read further:—"There is a prevalent notion that people gain strength by meat diet and spirituous liquors, and make themselves fitter for work, whereas the very reverse is the case. This will appear beyond a doubt if we look at horses and cattle, and compare their strength and 'fulness of life' with their mode of living." This is most lamentable reasoning. A horse or an ox is doubtless stronger than a man, being a very much larger and heavier animal. But neither horse nor ox has anything like the "fulness of life" of a healthy man. Both of them sink much more rapidly under continuous work. Drive, *e.g.*, an ox 40 miles a day for ten or twelve successive days, and note the result. But irrespective of this particular case, the author's mode of reasoning is thoroughly fallacious. Suppose any animal is stronger than man, it does not follow that man would gain in strength by imitating the diet of that animal. What would Dr. Hamernik reply to an anti-vegetarian who should turn his own argument upon him, and say—"This will appear beyond doubt if we look at grizzly bears and tigers, and compare their strength and fulness of life with their mode of living"?

We read further—"That the food taken finally influences the psychological character is made clear by even superficial observation and comparison of the sheep and the tiger, or the eagle and the dove."

Yes, decidedly by "superficial observation." Whoever will closely study the habits of animals will find that, though vegetarian species do not kill to eat, yet when possessed of sufficient strength and courage they frequently attack, and injure or kill, out of gratuitous malignity. It would be easy to name half-a-dozen species of Herbivora quite as dangerous as any beast of prey.

We regret to find such serious flaws and oversights in Dr. Hamernik's pamphlet, the more as in certain respects he has our sympathies.

Smithsonian Miscellaneous Collections. The Constants of Nature. Part V. A Re-calculation of the Atomic Weights. By F. Wigglesworth Clarke, S.B., Professor of Chemistry and Physics in the University of Cincinnati. Washington: Smithsonian Institution.

Early this year it became our duty ("Journal of Science," 1882, p. 1) to discuss the generality of the principle of Evolution, and in particular the probability of its extension to the chemical elements. In so doing, however, we considered it judicious not to lay any weight upon the law—or rather the hypothesis—of Prout, as not being sufficiently proven. The work before us tells decidedly in favour of that hypothesis, and as such is interesting not alone to the chemist and the physicist.

It may be needful briefly to recapitulate Prout's law. It assumes that, regarding the atomic weight of hydrogen = 1, the atomic weights of all the other elements will be multiples of 1 by some whole number. The bearings of this hypothesis, if demonstrated, are admitted on all hands to be exceedingly momentous. If the elements have existed independently from all eternity, if they have been formed—as the vulgar expression is—"by chance," or if they have been created arbitrarily, the probability of any definite relations existing between their atomic weights, or indeed any other of their properties, is vanishingly small. If, on the other hand, the elements have arisen under the action of some general law, if they mark out the successive stages at which permanence has been gained, we should then consider such relations as the one in question as *à priori* probable. Hence it is but natural that Prout's hypothesis should have been, from its promulgation in 1815 down to the present day, a disputed question. When it first appeared the determinations of the atomic weights, or, as they were then called, equivalents, were in the majority of cases of doubtful accuracy. Hence whenever exceptions appeared it was argued, not without plausibility, that with greater correctness these anomalies would disappear. This hope did not, however, hold good. Even when Dumas suggested the important modification that the atomic weights of the elements might be multiples of that of hydrogen by halves or quarters, as well as by whole numbers, the discrepancies were numerous, and the hypothesis fell more and more into discredit.

The recent researches of Marignac, and especially those of Stas, which have justly been regarded as models of accuracy, were generally recognised as fatal to Prout's law, since the atomic weights as thus determined agreed neither with whole, half, nor quarter multiples of that of hydrogen, and the variations seem wholly outside the range of experimental errors.

Recently, however, Dumas pointed out a source of error, previously overlooked, in the experiments of Stas. Many of the determinations of the latter chemist had necessitated the use of pure metallic silver, which was melted under a layer of borax and saltpetre. Dumas found that such silver absorbed and retained oxygen in ponderable quantities, thus rendering a correction necessary. On applying this correction Prof. Clarke finds that out of seven elements one has its atomic weight unaffected, one is rendered less accordant with Prout's hypothesis, but five are brought more closely than before to even multiples or half multiples of hydrogen. Thus in five cases out of seven the increased accuracy springing from the correction of Dumas tells in favour of Prout. It is also very possible that other metals, beside silver, when used in the determination of atomic weights, may also occlude gases.

The following argument in favour of Prout is put forward by Prof. Mallet:—Out of eighteen of the elements whose weights are best determined, ten have values which fall within one-tenth of a unit of whole numbers. Now if we examine what is the mathematical probability of such an approximation to the requirements of Prout's law being a mere coincidence, it will be found to be 1 as against 1097·8. In short, if half multiples are considered admissible, it seems more probable that the few apparent exceptions should be due to undetected constant errors than that the great number of close agreements should be accidental.

Prof. Clarke admits that he began his re-calculation of the atomic weights under a strong prejudice against Prout's hypothesis, but that the facts forced him to give it a respectful consideration.

It would of course be rash and premature to pronounce the question decided either way, but, having regard to the evidence collected and arranged by Prof. Clarke, the balance of probability seems to us to be in favour of Prout's hypothesis.

Guide to Practical Work in Elementary Entomology. An Outline for the Use of Students in the Entomological Laboratory of Cornell University. By Prof. J. Henry Comstock. Ithaca, New York: University Press.

The principal object of this little work is one with which we thoroughly sympathise. As a preliminary the author, however, discusses the need of what he calls a more "exact" nomenclature. It seems to him that "the use of the terms upper, lower, inner, outer, before, behind, anterior, posterior, and similar expressions in the technical descriptions of animals and their parts, has led to much ambiguity." A great part of this alleged confusion he ascribes to the fact that "very many of the early naturalists were physicians, and they attempted, in their descriptions of the lower animals, to avail themselves of the same terms that were in use in human anatomy. But as the natural position of man differs from that of the lower animals in being erect, these terms have in one case a different signification from what they do [have] in the other." We must here remark that we have never known a single case of ambiguity arising from this circumstance, nor do we even think it possible. Hence we can see no reason for the "improvements" in nomenclature which Professor Comstock is anxious to introduce. He quotes the dictum of Profs. Wilder and Gage, that biological nomenclature should include "only such terms as are brief, simple, exact, significant, of classical origin, and capable of inflection." The importance of brevity, simplicity, and exactitude we fully recognise; but to "classical origin" we demur, as being fatal to brevity and simplicity, and in many cases to significance. Of its sins against brevity no better instance can be taken than "perissodactylate" used instead of the plain English term "odd-toed." The days are gone by when every student of the natural sciences was a classical scholar. We have now, especially in Entomology, numbers of observers utterly unacquainted with Greek and Latin, and for their sake we demand the minimisation of classical terminology. Indeed, save as far as the names of species are concerned, there is little to be said for the Greek and Latin terms with which the sciences are flooded. International they cannot be called; the Germans, and still more the Dutch, use a technical language mainly of native origin, and intelligible to the people. The French use, indeed, words of classical derivation, but often so distorted that their meaning is by no means readily apparent. Why, then, should the English-speaking nations persevere in multiplying pseudo-classical terms? It seems to us grossly inconsistent to applaud, on the one hand, the foundation of colleges where the natural sciences only are to be taught without classical learning, and at the same time to teach the very same sciences in language which only the classical scholar can understand! Glossaries may lessen, but do not remove, the difficulty. The more the student is compelled to think of and puzzle himself with the *words* he meets with in his text-books, and the more he must load his memory with their meanings, the more are his time and attention necessarily withdrawn from *things*. Hence, whilst entertaining a high respect for Professor Comstock as an able and learned entomologist, we can only look upon his present pamphlet with profound regret. To us it seems an attempt to lay needless difficulties in the way of the student. What conceivable gain, *e.g.*, can arise from the substitution of the terms "ectal" and "ental" for outside and inside? What brevity, simplicity, exactitude, or significance is won by using "dextral and sinistral" instead of right and left?

The second part of this little work is of a very different character, and if translated into plain English would be an excellent guide to practical work in Entomology.

The Micrographic Dictionary. A Guide to the Examination and Investigation of the Structure and Nature of Microscopic Objects. By J. W. Griffith, M.D., &c., and Arthur Henfrey, F.R.S., F.L.S., &c. Fourth Edition. Edited by J. W. Griffith, M.D., &c., assisted by the Rev. M. J. Berkeley, M.A., F.L.S., and T. Rupert Jones, F.R.S., F.G.S. London: John Van Voorst. Parts I. to VII. 1881.

The last edition of this well-known work was issued in 1870. The numerous branches of Science of which this very comprehensive book treats have certainly not stood still during the past eleven years. The microscope itself has been greatly improved, in spite of the opinion expressed some years ago that it had nearly approached all that was theoretically practicable. At the date of the last edition the water immersion system of construction of the objective had not long been known, and only some of the advantages to be gained by its use realised; at the present time the homogeneous immersion glasses suggested by Mr. J. W. Stephenson, and their formula worked out by Prof. Abbe, have done that which was but a short time ago declared to be impossible. With the improvement of the instrument, those branches of Science dependent upon it for the means of investigation have advanced with proportional rapidity. It is indeed no light task which the editors have undertaken, to revise and add to the edition of 1870.

So far as can be seen, in the few parts at present published, the work appears to be well done. The all-important subject of bibliography has received great attention, and references are given almost to the date of publication. Taking the article "Angular Aperture," for instance, notice is taken of the diffraction theory of Abbe, which so entirely demonstrates the true function of aperture, although the prominence given to it is hardly so great as is needed for so neglected, but yet important, a subject. References are, however, given to the most recent papers on the subject.

Turning to Coal, the process for softening, by maceration in a solution of carbonate of potash, so that, as it is stated, sections may be cut with a razor, which has appeared in every edition, is still printed: the process has been tried frequently, without the least success. Surely the paragraph should be expunged, or an explanation given if it only refers to some particular kind of coal or lignite.

Many additions have been made to the illustrations, A very beautiful coloured plate of Rock sections, after drawings by Frank Rutley, is very welcome. Petrology is a branch of Science which has made gigantic strides: the microscope and polariscope have here done wonders Doubtless the subject will receive due attention in its proper place in the book.

With so small a portion of the work published it is difficult to know the exact extent of the change contemplated. Some of Tuffen West's beautiful engravings, which formed so prominent a feature in former editions, are still retained. It is to be hoped that a more correct representation of the Proboscis of the Blowfly than the old one on Plate 33 may subsequently appear: it is correct as far as it goes, being a true representation of the old flattened preparation; but the researches of Lowne and others, on uncompressed specimens, have given more accurate views of its structure.

A good series of cross references is arranged, and will materially help the student in finding the subject he is in search of, and, where space does not admit of so full an account as perhaps might be wished, the ample references to papers where fuller details can be found will supply the want; indeed, with the great variety of subjects contained in the work, no other plan would be possible without making an already large book of unwieldy dimensions. So far as can be seen, the present edition promises to equal, if not surpass, its predecessors.

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*Straggling Magnetic Lights.** By PHILIPP WALBURG KRAMER. Breslau.

WE have in this pamphlet vehement attacks upon medicine as taught and practised by the scientific physicians of the day, and

* Magnetische Streiflichter.

especially upon Prof. Virchow. The author, a professional mesmerist, relates a number of instances in which his treatment has proved signally successful—amongst others in a case of poisoning by phosphorus. Unfortunately he indulges in a violent outburst against physiological experimentation, and thus greatly shakes our faith in his own veracity, as we have generally found that particular monomania known as Anti-Vivisectionism to be accompanied by a tendency to state or to insinuate the thing that is not. Here Kramer tells us that phosphorus is condensed light and a vehicle for the powers of thought and will. The power of healing magnetism is probably connected with a high proportion of phosphorus in the brain. Sensitive patients have asserted that they can smell phosphorus on the author's skull!

A twofold process is constantly active in Nature, spirit being condensed into matter, and matter being again diluted into spirit.

We quote the following singular passage:—"If the famous *savant* Virchow could at last find the long-sought-for bone which bridges over the gulf between gorilla and privy councillor, it would seem to the learned professor that he had reached the very summit of celebrity." We had hoped that by this time everyone must be aware that no Evolutionist authority places privy councillors, or even anti-vivisectionists, on the same ascending line as the gorilla, and that the idea of the "missing link" is consequently about as rational as that of a bone connecting the tips of the thumb and the first finger. Moreover, is Herr Kramer sure that Prof. Virchow is an Evolutionist at all?

What practical power of healing diseases the author may possess we cannot of course pronounce, but his theories seem to us to belong to that anti-scientific movement which is now making itself felt in many countries. A feature of this movement is that persons unqualified by special study come boldly—it might almost be said impudently—forward, and lay down the law on the most difficult questions.

Geological Map of Sutherland. By M. FORSTER HEDDLE, M.D., President of the Mineralogical Society. Being No. 21 of the "Mineralogical Magazine." (Messrs. W. and A. K. Johnston.)

WE have here a very well executed geological map, on the scale of half an inch to the mile. The contour of the country is well expressed; the heights of the mountains are given, and, in addition to the colouring which indicates the fifteen formations occurring in this interesting county, dips, anticlinals, faults, and mineral localities are shown by special markings. Archæology has also not been neglected; the sites of old Pictish towers, of castles now destroyed, the localities of battles, &c., are given. The map is pasted on stout cloth, and folds up in a cover of convenient size. It will be an excellent companion for the scientific traveller in the North of Scotland.

The Manual of Colours and Dye-Wares; their Properties, Applications, Valuation, Impurities, and Sophistications. For the Use of Dyers, Printers, Drysalters, Brokers, &c. Second Edition, revised and greatly enlarged. By J. W. Slater. London: Crosby Lockwood, and Co.

The drugs and chemicals now employed in the tinctorial arts have become almost as numerous as those used by medical practitioners. Hence, just as the latter require special treatises on pharmacography and materia medica, so the dyer, the colour-mixer, &c., need the work before us. On the appearance of the first edition, indeed, a pharmaceutical contemporary designated it as a work on "*Materia tinctoria.*" These two words mark out very clearly the position and the scope of the present book. It is no general manual of dyeing or tissue printing. It does not give instructions for the production of this, that, or the other colour upon any given class of materials. Nor, on the other hand, does it explain the manufacture of alizarine or eosine, of red liquor or tin-crystals. It takes up in alphabetical order the several colours, mordants, and other requisites; describes their sources, properties, and uses, the appearance which they should present, the impurities—accidental or intentional—which they may contain, and the simplest means by which such imperfections may be detected. There are also instructions for ascertaining the colours with which any given sample of yarn or cloth may have been dyed or printed. An attempt has been also made to furnish a synonymy of the aniline and other artificial colours, a subject upon which there prevails no little confusion. As the author says, in the tone of one who has himself suffered from the want of system now prevailing, "One and the same substance is sold under different names, and, in return, bodies chemically and practically distinct are confounded under the same name. Not merely inventors and manufacturers give names to new products, but even retail dealers assume the same privilege. Thus we have to deal with a most perplexing chaos." In illustration we find, on examining the work, that there are no ewer than three "xylidine reds," one of which belongs to a totally distinct class from the other two, and requires a different procedure in its use. The well-known red colour, once in such high request, commonly known as magenta, is called, in strictly scientific circles, rosaniline acetate, whilst among dealers and consumers it often receives such names as roseine, fuchsine, fuschine, fuchsiacine, azaleine, and rubine. "Harmaline" was originally and rightfully a red colour obtained from the seeds of the Syrian rue (*Peganon harmala*), used to some extent as a dye in the East and in Russia. But when the coal-tar colours were first brought out some inventor or patentee appropriated the same name to an aniline violet of the same class as the original "mauve" of Perkin. Others adopted the same misleading principle, and gave to various colours derived from aniline names taken from those of flowers. On the other hand, the strictly scientific names given to the new colours, being for the most part drawn up by German authorities, and embodying theoretical views on the constitution of the compounds in question, are far too long for the use of ordinary mortals. A further source of confusion is, that certain dealers—not perhaps of the highest standing—buy colours from the manufacturer, mix them if practicable, give them a new name, and advertise them as novelties not to be procured elsewhere.

This confusion is not merely a theoretical evil, but a very matter-of-fact nuisance, and though Mr. Slater does not profess to have completely disentangled the web, he has done very much towards it. Henceforth if dyers buy lots of one and the same colour, because offered them under different names, it will be their own fault.

The work contains very much information which may be called original, having never appeared in print prior to the former edition. This matter is generally distinguished by its accuracy and strictly practical character. The subject of mordants was especially treated with a clearness and thoroughness which had never before been equalled, and not a few errors which had found their way into widely circulated books were corrected. Thus it might scarcely be believed that authors on tinctorial subjects were ignorant of the palpable fact that "double muriate of tin" is not a stannic but a stannous chloride. These features have all been retained in the present edition. The additions made are numerous and important, relating of course mainly to dyes and colours introduced into commerce during the last few years. Amongst these figure African red, alizarine blue, alneine, anthracene blue, anthracene orange, anthracene violet, aureosine, benzaurine, beth-a-barra wood, Biebrich scarlet, Blackey blue and orange, benzyl blue, Bordeaux, calliatura wood, campobello yellow, cannelle brown, cauline, chlorozone, chrome alum, chrysoline, coccine, cœruleine, cyanogen purple; the malachite, solid, and methyl greens; enthylrosine pink, eosine and its modifications, galleine, the indophenols and indulines, laureline, the oranges and tropæolines, rose Bengale, saffrosine, &c. On the other hand, certain dye-wares—which were spoken of at length in the first edition—have passed to such an extent out of use that they now need and receive but scant mention.

The principal omission which we detect is croceine scarlet, a colour which is now coming rapidly to the front, both in wool and cotton dyeing. Bisulphide of carbon has by some oversight been twice mentioned. As a whole, however, this manual carries out in a most satisfactory manner what it undertakes to do. The descriptions of the various dye-wares, &c., are singularly clear and concise, and there is throughout the work a complete absence of that "tall talk" and assumption of omniscience which too often render technological manuals at once unintelligible and repulsive to the busy practical man. The former edition was deservedly a favourite among those best able to judge, and we consider that the work in its present revised form will receive still wider approbation. There is an exceedingly copious index, and the getting up of the book reflects great credit on the publishers.

Records of the Geological Survey of India. Vol. XV., Part 2. 1882.

In an examination of certain Siwalik and Narbada fossils, Mr. R. Lydekker, F.Z.S., concludes that Falconer's subgenera *Hexaprotodon* and *Tetraprotodon* must be abolished, as their distinctive characters are found in the same species. It seems, further, almost certain that it is the second pair of incisors which is suppressed in the African hippopotamus. This circumstance may prove of some importance in determining the homologies of the incisors in other Ungulates—*e.g.*, *Rhinoceros*—in which the whole of the typical series is not developed.

A molar tooth of *Mastodon sivalensis*, from the Punjab, is described as presenting a peculiarity in the arrangement of the enamel not heretofore recognised in the teeth of the *Proboscidia*. The enamel is thrown into a number of folds, placed at regular intervals from each other, which penetrate into the dentine of the cones and converge towards their centres. The horizontal section of one of these cones displays a structure, as regards the depth of the folds of the enamel, intermediate between that of the teeth of *Ichthyosaurus* and *Labyrinthodon*.

Mr. Lydekker gives also a catalogue of Captain Searle's collection of fossils from Perim Island,—not, we presume, the Perim in the Red Sea.

Some ophidian vertebræ from the Siwaliks seem to be identical with those of the still living species, *Python molurus*.

Mr. Ball, F.G.S., contributes an account of the coal-bearing rocks of the upper Rer and Mand Rivers. He is disposed to regard the economic prospects of the district favourably.

Mr. Blanford, F.R.S., gives a full report on the Pench River Coal-field, in the Chindwara district. He pronounces the coal perfectly fit for railway purposes. The general condition of the country is favourable for the establishment of collieries.

Mr. F. R. Mallet, F.G.S., reports on sapphires recently discovered in the north-western Himalaya. The exact locality is not given, but it is in the neighbourhood of Padam, in the Zamskar district, within the territory of Kashmir. Two specimens, sent officially to the office of the Geological Survey for examination, were found to possess the physical and chemical characters of true sapphire. Some specimens contained considerable cavities, enclosing two crystals of tourmaline. The sapphires are found dispersed in a stratum of a white material said to resemble soda. Below this is a blue solid rock. The thicker end of a large broken crystal "looked for about an inch like topaz, the colour being that of deep-coloured sherry, quite transparent," whilst at the other end it was blue, the two colours fading gradually into each other. Practical jewellers inform us that stones are occasionally met with which are sapphire in one part and ruby in the other.

The Field Naturalist and Scientific Student : a Medium of Intercommunication. No. 1. Manchester: Abel Heywood and Son.

It is somewhat remarkable that whilst, with the single exception of elementary manuals, independent scientific works rarely make their appearance, new periodicals on scientific subjects spring up almost as plentifully as new religious sects, with this difference, that they do not find so extensive constituencies. The journal before us approximates somewhat in its character and aims to our old friend "Science Gossip," and contains some interesting matter.

Mr. C. E. Axon contributes a short paper on the "Topographical Distribution of the Nightingale in Britain." Among the counties where this bird is a regular visitor the author omits Bucks, where, in the Aylesbury district, its song is heard every spring. Nor is the fact brought out that the nightingale is more plentiful in the south-east of England than in the south-west. It is very sad that this charming songster is so much exposed to the snares of the bird-merchant and to the guns of brutish idiots.

A F.R.S., in a batch of somewhat singular queries, asks, "Is it as wicked to sell starch for food, and to say that it contains all the elements of food, as it is to put water into milk?" We should say that it is much more wicked, since the watered milk still contains its nutritive elements, though in a reduced proportion, whilst the starch is entirely devoid of albumenoids and fatty matters, and is absolutely incapable of assimilation by young children. But the law of libel throws its shield over quacks of every grade, and until it is mowed down a good many stages it is a hazardous task to look after public health.

"A Manchester Pythagorean" writes on the coming and going of the swallow, and gives the day and month of their arrival, the years not being stated. We should expect the season when they were noticed on April 1st, in so bleak a locality as Barnsley, must have been exceptionally genial.

The Rev. E. M. Geldart communicates a characteristic anecdote of the great naturalist whom we have just lost. Some boys found first a *Dytiscus*, and afterwards some frogs with small fresh-water mussels clinging to their hind legs. They made bold to communicate this observation to Darwin. "In return they received a very kind answer, thanking them for the light they had thrown on a problem which had long puzzled him, viz., How it came about that mussels, which can neither fly nor walk, can migrate from one pond to another."

The Hon. Percy Wyndham, M.P., writes on the sense of locality in animals, a subject on which more extended and more definite observation is needed before we can attempt to theorise.

Memoirs of the Geological Survey of India. Vol. XVI., Part 2. Calcutta: Geological Survey Office. London: Trübner and Co.

This part contains an account, by Mr. W. King, B.A., of the Gneiss and Transition Rocks, and other formations of the Nellore portion of the Carnatic. The author, in his general description of the region, remarks that both the soil and the waters of most of the streams, with the notable exception of the Penner, are charged with soda, and are consequently barren.

A curious ethnological fact is mentioned: the Yanadis, a remnant of a decaying race, who inhabit the island of Sriharikota and the waste jungle lands of its neighbourhood, though within an easy distance of Madras, are still in a very primitive condition. "An iron arrow-head is treasured by them as a rare thing; the points of their wooden arrows are hardened by charring, and they are in the habit of obtaining fire by the friction of wood."

The mineral wealth of the district is not great. Schorl has at times been mistaken for coal. Diamonds are said to have been found, but the author has not been able to obtain any trustworthy information as to the exact locality or the supply. There is, however, an *à priori* possibility of their existence in the Penner Gorge. There are beds of iron ore in the southern part of the region, but the metal has never been regularly smelted. There are signs of fairly rich copper ore on the northern side, but the attempts at their utilisation made within the last half century have been costly failures.

The Opium Habit; its Successful Treatment by the Avena Sativa. A Paper read before the New York State Medical Society, February 9th, 1882. By E. H. M. Sell, A.M., M.D., &c. New York: Bermingham and Co.

Admitting for argument's sake—and it is a fairly strong concession—that the " opium habit " is as dreadful as it is pictured by professional philanthropists, and granting likewise that some principle or principles contained in the common oat cure the opium-eater and smoker of their craving for the drug, we do not see why oatmeal porridge or gruel should not simply be used in place of the extract here recommended.

CORRESPONDENCE.

*** The Editor does not hold himself responsible for statements of facts or opinions expressed in Correspondence, or in Articles bearing the signature of their respective authors.

NOTES ON EXPERIMENTS ON THE ABSORPTION OF DYES BY FLOWERS.

To the Editor of the Journal of Science.

Sir,—With the desire to throw further light on the physiology of plants the following preliminary experiments have been undertaken:—

Solutions were made of the following eleven aniline dyes, viz., alkaline blue, eosine, aniline black, tropeoline and methyl green, magenta, chrysoidine, Bismarck brown, methyl violet, benzyle blue, and malachite green, and a white narcissus placed in each solution. In less than an hour the base of the perianth of the narcissus in the eosine became veined with pink; very shortly afterwards the flower in the methyl green showed veins of colour; next, that in the alkaline blue became veined with blue, while the narcissi in the aniline black and in the tropeoline did not absorb colour until several hours later; but the remaining six aniline dyes—viz., magenta, chrysoidine, Bismarck brown, methyl violet, benzyle blue, and malachite green—were never absorbed at all, although the flowers were left on several occasions a couple of days in the solutions.

It was also observed that the absorption of colouring-matter differed in manner as well as time; thus while eosine invariably coloured the base of the perianth, fading gradually, and leaving the edges of the segments unchanged, alkaline blue always appeared first at the edges of the segments of the perianth, while the base remained wholly, or almost wholly, white. Again, whilst those narcissi in the respective solutions of eosine, alkaline blue, aniline black, and tropeoline became *veined* with colour either at the base or edge, in the case of methyl green the colour spread over the whole surface of the perianth, the venation of the flower not being in any way manifested.

As it was found that the flowers were always consistent with themselves in the manner in which each dye was absorbed, a narcissus was placed in a mixed solution of eosine and alkaline blue, and the flower then actually performed an analysis, the blue appearing in all its brightness at the edges of the segments of the perianth, and the eosine in unchanged pinkness at its base. This experiment was repeated many times, and always with the same beautiful result.

The experiments having been carried thus far with the anilines, it was determined to try whether absorption would also take place with animal and vegetable colouring-matters.

Solutions were made of indigo and cochineal, the latter in two forms, *viz.*, aqueous solution of the crushed insects, and also ammoniacal solution of *pure* carmine. The indigo was absorbed very slowly, following the venation of the leaves in the manner of the majority of the anilines absorbed: it exhibited, however, one marked peculiarity, *viz.*, that of fading in about twenty-four hours, and not, like the anilines, lasting during the life of the flower. Cochineal was absorbed in both forms, in each case following the venation of the petals; the colour collected at the edges as with alkaline blue, but to a more marked extent, especially in the case of carmine, which in every case gave colour save to the edges of the petals. The solution of carmine was perfectly clear when the flowers were placed in it, but in less than twenty-four hours it became turbid, although the same solution, under the same circumstances, would remain—if flowers were not placed in it—clear for three days.

The dyes experimented with were found to differ not only in time and manner of absorption, but also in a very marked degree in the influence they exercised on the life of the flower,—carmine, cochineal, alkaline blue, and methyl green being apparently quite innocuous, but aniline black and eosine being distinctly injurious, the flowers fading very rapidly after their absorption. This would appear specially curious as regards eosine, for not only is it used in small quantities in confectionery, but rabbits may be fed continually, and will fatten on food highly charged with it. Nevertheless to flowers it would appear poisonous.

Both the single and double narcissi have been used for these experiments (the double narcissi absorb much more rapidly than the single), also the ox-eye daisy, pinks, and sweet pea; and it has been found that not only do the segments of the perianth absorb colour, but also the corona of narcissi, the stem and calyx in peas and pinks, and sometimes also the stamens. Of absorption by the stamens, which occurs less frequently, the white pink is an instance.

If cuts be made partly across the petals, and the flower be then placed in the dye, the colour will pass up by the side of the cut, and then spread in the upper part of the petal over the cut. This is fully shown in the sweet pea, in which flower the veins are completely coloured over the incision; but in the daisy the colour returns by one or two veins only, leaving a white space over the cut. This experiment is very interesting as showing the nature of the venation of the petals and segments of the perianth, and is an illustration of the similarity of the construction of the petals and perianth.

Of the colouring-matters mentioned above it has been found that none of those which are precipitated by carbonate of soda are absorbed by flowers.

By using white flowers, and placing them in various solutions of dyes, the beauty of the specimens that can be obtained almost surpasses the power of imagination : thus we have a white flower with a delicate green centre ; one consisting entirely of the most splendid emerald-green ; one delicately veined with pink ; another firmly dashed with red through the whole of its petals ; and, lastly, one in which the flower has decorated itself by separating from a mixed solution the blue which it judiciously divides from the pink, placing it in a beautiful fringe at the edge of its petals, while carefully reserving the pink as a contrasting uniform tint for the centre of the flower.—I am, &c.,

A. A. Nesbit.

THE SYNTHESIS OF ORGANIC COMPOUNDS.

To the Editor of the Journal of Science.

Sir,—Allow me briefly to remark upon a statement which occurs in a review of Dr. Cleland's " Relation of Brain to Mind," in the May number of the " Journal of Science." The sentence to which I refer is the following :—" It may not be irrelevant to point out that the organic syntheses, of which modern chemistry is so proud, start not from *bona fide* dead matter, but from the remains of what was once living." Here you of course allude to the production in the laboratory of such substances as camphor, the artificial glucosides, the indigo group, and other complex bodies ; but the words quoted, if taken literally, may prove misleading to some of your less scientific readers. It is indeed evident that compounds such as the above are subject to the same laws which determine the simplest chemical union, and that no argument can be based upon the apparent impossibility of producing them from their elements. The word " organic," as applied to the chemistry of the carbon-compounds, is universally recognised as a misnomer, in so far as it implies the agency of some peculiar vital force in animal and vegetable organisms, which does not exist in the mineral world. So soon as the paraffins and cyanides were formed from " dead matter," the synthetic preparation of the corresponding alcohols, aldehyds, acids, and ethers became (as indicated by Berthollet in "La Synthèse Chimique") theoretically possible, and the theory has already been reduced to practice in so many cases that we may probably regard the formation, in like manner, of all remaining "organic" compounds as a mere question of time and patience.—I am, &c.,

CONSTANCE ARDEN.

DIPTEROUS LARVÆ IN HUMAN BODIES.

To the Editor of the Journal of Science.

SIR,—I find it stated, at page 373 of the present volume, that the medical papers give several instances of larvæ, and apparently Dipterous, having been found in human subjects in this country. The subject is one in which I take considerable interest. The only instance with which I am familiar is a case brought before the International Medical Congress, by Dr. Walter G. Smith, of Dublin, who stated that a girl, aged 12, presented herself with the following history:—About three months before being seen by a medical man an ovoid swelling appeared on the outer side of the right ankle, causing her some pain and uneasiness in walking. This swelling gradually shifted its position, and slowly moved up the leg, thence towards the right axilla, then down to the elbow, and finally settled on the back of the neck. In this position a small dark spot appeared, an orifice formed, and, when pressure was made around this opening, a white grub, nearly an inch in length, protruded, and escaped along with some unhealthy pus. Several other similar swellings developed upon subsequent occasions under medical observation, and the medical man extracted other grubs exactly similar to the first specimen. No cause could be assigned for these curious phenomena. The larvæ were pronounced by competent authority to belong to a Dipterous insect, although the genus could not be satisfactorily determined. There was no sufficient proof of the existence of an *Œstrus* peculiar to man alone.

A good abstract, from which the above is quoted, appeared in the "British Medical Journal," October 1st, 1881. I shall feel grateful to any of your readers who will give additional information or references.—I am, &c.,

WILLIAM E. A. AXON.

Fern Bank, Higher Broughton.

THE STUDY OF PRE-HISTORIC MAN.

To the Editor of the Journal of Science.

Sir,—The law of England is fruitful in ways and means for the discouragement of scientific research. With the Anti-Vivisection Act we are all only too well acquainted: the dangers of conducting a *post mortem* examination without a consent which it is not easy to obtain from the ignorant have been recently brought under public notice, and now there appears a third difficulty which is strongly felt by ethnologists and palæontologists. If any human —or I suppose anthropoid—remains are found in the earth, no matter of what apparent age, even if they should be fossilised, the law requires that a coroner's inquest should be held upon them, and that they should then receive "Christian burial." In this manner evidence of priceless value concerning the pre-historic inhabitants of these islands may be withdrawn entirely from scientific examination. If I am not very much mistaken some skulls (if not entire skeletons) in France have been lost. The local Maire—who, sad to say, was a medical man—ordered their re-interment in consecrated ground, and when at last the higher authorities consented to their transfer to a museum it was discovered, or at least alleged, that the place where they had been deposited was forgotten; and thus the specimens have been lost. Surely some alteration of the law is here needful, though it will doubtless be obstinately resisted by the "Anti" party.—I am, &c.,

Archæologist.

THE PROPAGATION OF SPLENIC FEVER.

To the Editor of The Journal of Science.

Sir,—Certain facts connected with the propagation of "charbon," as it is called in France, seem to have not merely a profound scientific interest, but throw a strong light upon one of the burning questions of the day. The temperature most favourable to the development of this disease is that of mammalian blood, say from 98° to 100° F. Birds, and especially the common fowl, whose blood has a temperature of 107° F., do not contract the disease under ordinary conditions. But M. Pasteur has shown that if the temperature of a hen is reduced by a prolonged immersion of the feet in cold water, she then becomes susceptible to the disease.

Proceeding in the opposite direction, M. P. Gibier has shown, in a paper lately read before the Academy of Sciences, that cold-blooded animals,—*e.g.*, the frog,—though ordinarily insusceptible, can be rendered liable to the disease by placing them in water of about 95° to 98° F.

Now I should like to ask those "Anti-Vivisectionists" who are neither fanatics nor charlatans seeking to advertise themselves, how the above facts could possibly have been ascertained without experiments on living animals? Unless they are prepared to point out some method they can no longer maintain that Vivisection is useless. If they maintain that the facts are unnecessary, because perhaps not immediately applicable in practical medicine, they place themselves on the very lowest "plane" of purblind Philistinism. Now the value of abstract research is being admitted by manufacturers, are even a minority of medical men about to raise the standard of immediate utility?

Freiburg in Breisgau.

MISTAKEN "INSTINCT."

To the Editor of the Journal of Science.

Sir,—In South Africa horses are passionately fond of the so-called "Caffre corn," and will stray away to great distances to get at a piece of ground where it grows. In small quantities it seems to be perfectly harmless, but if indulged in freely it makes the animals seriously ill, and not unfrequently proves fatal. Is not this a case of mistaken instinct?—I am, &c.,

E. A. S.

NOTES.

Dr. Brown-Séquard ("Comptes Rendus") concludes that no value can be attached to one of the principal bases of the doctrine of psycho-motor centres, and of the generally received theory with regard to the relations between one side of the encephalon and the opposite side of the body for voluntary movements and for unilateral convulsions. It must be admitted that the excito-motor *zone* of the cerebral surface, as well as all the excitable parts of the encephalon, are capable of setting in movement the members of the corresponding side as well as those of the opposite side. They can produce these effects even after the transverse section of a lateral half of the pons varolii, of the bulb or of the cervical medulla, or even after two sections, the one of the right half and the other of the left half of the base of the encephalon, on condition that a certain interval exists between these two sections.

On May 1st M. de Quatrefages delivered before the Academy of Sciences the formal *éloge* of Charles Darwin. His discourse has seemed to some persons as of "almost inspired eloquence." If we look below the surface we find that the orator was far from rising to the level of the occasion. There is, indeed, no trace of the charge at one time commonly made by the official science of France, that Darwin was a mere amateur. But the speaker defends the Academy with regard to its discreditable rejection of our great naturalist when first proposed as a corresponding member, and actually states that in so doing it "had fulfilled its duties as a scientific tribunal with a high impartiality"! We regret that after this first rejection Darwin honoured the Academy by accepting the subsequent reversal of its former verdict.

According to the "Lancet"—"To the sick, suffering from headache and nervous irritation, the ding-dong and dangle of church bells constitute a very serious annoyance; and we do not hesitate to say, in many cases, the loss of rest and the general disquietude they produce not only lessen the chances of recovery, but may expedite a fatal issue. This is a grave charge, but we make it advisedly."

Taking up the same subject, the "Boston Journal of Chemistry" remarks—"We may add that dogs frequently make night hideous to the well and unendurable to the sick, and the blood of the victim be upon the head of his neighbour who keeps a howling dog. The incessant rattle of a piano is scarcely less annoying to the invalid and convalescent, but sometimes their owners are sufficiently humane to cease the nuisance when asked to do so; but dog-owners and church sextons rarely possess this virtue, and wise laws should be enacted to protect weak and suffering humanity."

For our opinion on this subject we may refer to the "Journal of Science" for 1880, p. 572.

M. L. Fourment ("Comptes Rendus") proves that salting is not necessarily fatal to Trichinæ embedded in meat; that they may live in salt provisions for fifteen months; and that salting to some extent even withdraws them from the action of heat.

Mr. F. Podmore, B.A., writing in the "Psychological Review," calls attention to the sensitiveness of dogs and horses to ghostly visitations, and considers it "additional proof of the entirely material character, in many instances, of these apparitions."

According to M. R. Kœhler ("Comptes Rendus") crossed fecundations are possible within very wide limits among various species of Echinoidea, differing respectively as much as do two mammals belonging to two adjacent orders. The fecundation is not reciprocal. The ova of *Spatangus* are perfectly fecundated by the spermatozoids of *Psammechinus*, whilst the ova of the latter, if submitted to the male secretion of *Spatangus*, remain intact, or reach at most the blastula stage.

The resignation of Mr. E. Ray Lankester still excites discussion. It seems he would have been required to make formal promise to teach nothing contrary to the "confession of Faith." If so we cannot greatly wonder at his resolution, for how is any man not a theological specialist to know what might or might not be held to be contrary to the said confession?

M. N. E. Sauvage reports to the Academy of Sciences on certain fossil reptiles discovered in the gault of the east of France by MM. L. Pierson and C. Barrois. Amongst other forms is a *Megalosaurus* distinct from *M. Bucklandi*. The distal extremity of the femur of an adult specimen measures 0·470 metre in circumference at the condyles, which points to a prodigious size. A *Pythonomorpha* has also been discovered of the genus *Dacosaurus*.

According io the "Pharmaceutical Journal" potatoes, if unripe or too old, contain a certain quantity of solanine, and may produce serious results if boiled with the skins on, especially if eaten in large quantities.

The British Museum, in its place of exile, will shortly be enriched by the two valuable collections of fossil fishes formed respectively by the Earl of Enniskillen and Sir P. G. Egerton.

According to Arago, Comte had no claims to eminence as a mathematician.

Dr. G. Wylde (" Light ") mentions as a curiosity the presence of Prof. E. Ray Lankester at a meeting of the " Salvation Army," where he seemed like a fish out of water.

We learn that Prof. Tyndall has subscribed £50 to the proposed Carlyle monument. A friend of ours suggests that in so doing the learned professor has, to use an Irishism, " turned his back upon himself."

M. Torcapel, in a communication to the Academy of Sciences, describes a number of mammalian remains found amidst volcanic *débris* at Aubignas, in Ardèche. Among the forms are *Machairodon cultridens*, a large unknown cat, *Hyœnarctos*, a rhinoceros, a *Hipparion*, &c.

The " Medical Press and Circular," in an article in favour of the re-forestation of India, gives facts proving that cholera is far more deadly in the open country than in wooded districts.

The fanatical enemies of physiological research have had a meeting in Edinburgh, and have shamelessly reproduced the statement that vivisection is " scientifically unnecessary."

According to M. Danillo (" Comptes Rendus ") the progress of poisoning by absinthe presents a certain analogy with the effects of strychnine.

MM. Arloing, Cornevin, and Thomas have proved that if a cow is inoculated against anthrax during gestation, her calf obtains immunity against the disease.

MM. Paul Bert aud P. Reynard (" Comptes Rendus ") state that the peroxide of hydrogen, even when very dilute, arrests fermentations due to the development of living beings, and the putrefaction of all substances which do not decompose it. It has no action upon the ferments of the diastase class. In a dilute state it is not destroyed by fatty bodies, starches, soluble ferments, egg-albumen, caseine, the peptones, creatine, creatinine, and urea. It is quickly destroyed by collaginous matters, musculine, blood fibrine, and various nitrogenous vegetable principles.

Two ships' captains have mentioned to M. Knipping (" Ciel et Terre ") an extraordinary oxidation of metals observed at the centre of a typhoon. He asks whether this phenomenon depends on an excessive production of ozone due to the friction of the air on liquid particles?

The new Society for Psychical Research is at work; the first Report of its " Thought-reading Committee " has been made public.

C. G. Massey (" Psychological Review ") defines organism as " the result of force beating down a path for itself.'

According to the "Popular Science Monthly" candidates for professorships in American colleges are almost invariably asked, "What church do you go to?" "What are your views upon such and such doctrines?"

The "Psychological Review" gives a series of ghost-stories, which "M. A., Oxon" guarantees to be the authentic records of actual fact. We regret to find that "Gifford"—one of the interlocutors—is made to drag in a very irrelevant outburst against physiological experimentation.

The "American Journal of Medical Science" maintains that "mesmerism" ought not to serve as an object of amusement, or an aliment for public curiosity, but should be employed solely for scientific objects.

The "Textile Record of America," a weaver's and spinner's organ, has taken up its parable against Evolution!

Mr. F. M. Balfour, F.R.S., has been appointed to the new Professorship of Morphology at Cambridge. It would have been difficult to find a more competent man.

According to Œchsner de Coninck ("Journal de la Soc. Biologique"), β-collidine, a pyridic base derived from cinchonine, is strongly poisonous. If injected subcutaneously, in doses of from 0·05 to 0·15 grm., it occasions general and progressive debility and paralyses the action of the psycho-motor centres. The reflex movements remain intact, save those of the cornea, which are completely abolished. The heart is finally arrested in diastole.

Prof. E. J. Maumené ("Les Mondes") considers that classical chemistry is, in theory at least, nothing but a long tissue of errors.

M. F. Raoult, in a communication to the Academy of Sciences, shows that the lowering of the freezing-point of water, produced by dissolving in it equal proportions of organic substances, follows a well-marked law. If the molecular weight of the substance is multiplied by the reduction of temperature corresponding to 1 grm., the product obtained is approximately constant.

M. C. V. Zenger ("Comptes Rendus") proposes a new combination of objectives for the microscope, by which he obtains a magnifying power of 2000 diameters, with a focal distance of 0·004 to 0·006 metre.

According to H. L. Hermann ("Pflüger's Archiv für Physiologie") seeds germinating in water, or in moist materials, show a perfectly regular and powerful electric current, the roots being negative to the cotyledons. The power often exceeds 1-10th Daniell.

H. T. Fuchs ("Verhandl. K. K. Geolog. Reichsanstalt") shows that the distinction between the littoral and the abysmal faunæ depends not on temperature, but on light. Many abysmal forms are phosphorescent, but not a single littoral species. There are interesting relations between the abysmal forms and the faunæ of caverns.

H. W. P. Wilson ("Flora") finds that in many plants the excretion of carbonic acid decreases at once if a supply of oxygen is excluded. Hence the view that the carbonic acid exhaled by plants has its origin in inter-molecular decompositions, indedendent of the oxygen of the air, is untenable.

Mrs. A. Kingsford, M.D. ("Light") assures the world that she "will scold" on the Vivisection question. Who ever doubted it? A certain "Isabel de Steiger" follows on the same side. We remind these talkative ladies of a truth uttered in the same number of "Light"—"The age of sentiment is not gone, but the age of sentiment without sense will have to go!"

The "Medical Press and Circular" gives an account of a canary, belonging to Dr. J. McGrigor Croft, which, in addition to the usual song of its species, utters a number of sentences with remarkable clearness and precision.

The same paper gives some curious instances of the "commercial instincts" displayed by certain Scotch University professors.

Prof. Bastin ("Proc. Amer. Pharm. Assoc."), whilst botanising with his class at the southern end of Lake Michigan, met with a curious case of atavism in *Cypripedium spectabile*,—a perfectly regular blossom growing on the same stem with one that has the ordinary form. It had three sepals, distinct, and of equal size; it had no lip, but the three nearly equal petals were shaped alike. The ovary was not twisted at all. Prof. Bastin considers that this monstrosity proves that the *Cypripedium* of the present day is derived from a remote ancestral form which was regular, or nearly so.

The "Mineralogical Magazine and Journal" for February mentions, among minerals new to Britain, the following:—Halloysite, found in the Hospital Quarry, Elgin; fibrolite, from the north-west side of Pressendye Hill, Aberdeenshire, and Clashnaree Hill, in Clova; martite, found on the north-west shore of Bute; turgite, in clay slate in the island of Kerrera, in Argyleshire, and to the east of Oban; and Xonaltite, found along with gyrolite near Kilfinnichan, Loch Scredin, Mull.

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THE

JOURNAL OF SCIENCE.

AUGUST, 1882.

I. OCCULTISM RECONSIDERED.*

(Concluded from page 409.)

IN what sense the Occultists pronounce the soul a "material reality" is not quite clearly shown. Mr. Sinnett writes, "Not material as chemistry understands matter, but as physical science *en bloc* might understand it if the tentaculæ of each branch of science were to grow more sensitive, and were to work more in harmony." The author here scarcely recognises the great and increasing harmony between physics and chemistry, which are becoming more and more difficult to distinguish from each other. We are naturally reminded of the speculations of Prof. Jäger which were discussed in the "Journal of Science" for 1880 (p. 298). With him, as with Mr. Sinnett, the spirit is a more subtle principle, the "soul of the soul." But the chief point to be noted is this—to the vast majority of educated Europeans in the present day man is essentially during life a unitary being, capable of perceiving and acting only where his body happens to be. This body he neither views as his "dwelling" nor as his "prison," but, for the present at least, as himself. The sole difference between the monist and the ordinary philosophically and theologically orthodox dualist is that, according to the former, personality and consciousness are finally extinguished at death, whilst the latter considers that the soul or the spirit, which he does not sharply diagnose, will survive the decomposition of the body. The

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* The Occult World. By A. P. SINNETT. Second Edition. London: Trübner and Co.
Zanoni. By Lord E. BULWER LYTTON.
A Strange Story. By Lord E. BULWER LYTTON.

Occultist dissents from both. According to Mr. Sinnett—"The body is the prison of the soul for ordinary mortals. We can merely see what comes before its windows; we can take cognisance only of what is brought within its bars. But the adept has found the key of his prison, and can emerge from it at pleasure. In other words, the adept can project his soul out of his body to any place he pleases." Elsewhere we read—"While his body lives his soul is, so to speak, a captive balloon, though with a very long, elastic, and imponderable cable."

The practical differences resulting from these opposite views are immense. Thus to us gross stupid Westerns the very idea of asceticism appears absurd. The attempt to get more and better work out of our system by suppressing its natural functions, by fasting, dirtiness, inaction, and, as far as possible, by dispensing with respiration, seems as foolish as it would be to try to obtain more duty from a steam-engine by neglecting to supply it with fuel and to oil and clean it. But if the connection between soul and body be such as Mr. Sinnett alleges, it is conceivable—though certainly not proved—that what invigorates the one may debilitate the other, and inversely. We cannot help adding that both history and observation prove the general effects of asceticism to be distinctly degrading.

The doctrine of metempsychosis is plainly taught. Koot Hoomi speaks of "man's true position in the universe in relation to his previous and future births."

Spiritual beings other than human are referred to. Some are of a lower grade:—"Those semi-intelligent Forces whose means of communicating with us are not through spoken words, but through sounds and colours in correlations between the vibrations of the two. For sound, light, and colour are the main factors in forming those grades of intelligences, those beings of whose very existence you have no conception, nor are you allowed to believe in them,—Atheists and Christians, Materialists and Spiritualists, all bringing forward their respective arguments against such a belief,—Science objecting stronger than any of these to such a degrading superstition."

But there are more exalted beings, "the higher planetary spirits, the only spirits we believe in." These last words are significant.

A few pages further we read that humanity, "in this everlasting isolation and neglect, has evolved gods unto whom it ever cries for help, but is not heard." Again, and more decidedly, Koot Hoomi is made to say—"If we had the powers of the imaginary personal God." We by no means wish to brand Occultism as one phase of Atheism, or to invoke against it the *odium theologicum*. But it strikes us as somewhat strange that rejectors of a personal God should yet call themselves "theosophists"!

A prominent point in the philosophy of the Brotherhood is that it dispenses with the notion of time, at least as commonly understood. Says Koot Hoomi:—"I feel even irritated at having to use these three clumsy words—Past, Present, and Future. Miserable concepts of the objective phases of the subjective whole, they are about as ill-adapted for the purpose as an axe for fine carving."

We come now to the most important point of all—the evidences. We find in the work before us most startling assertions; how are they to be verified? How are we to satisfy ourselves that certain recluses in the mountains of India and Thibet possess knowledge far beyond that of our most gifted investigators, and power which from our point of view must appear superhuman? We are far from asserting, or even from wishing to insinuate, that Koot Hoomi is a myth, or that Madame Blavatsky, Col. Olcott, and Mr. Sinnett are dupes or deceivers. But it cannot be forgotten that impostors—*e.g.*, Cagliostro—might make assertions quite as strong, and apparently sincere, and advance claims quite as lofty as any we find in the "Occult World." Where, then, are we to look for satisfaction? Occult Science does not appear to have ever aimed at industrial applications, or if it has they have been kept concealed, so that one class of evidences of necessity fails us. The only proofs here brought forward are certain "feats"—we take the word from Mr. Sinnett himself—said to have been performed. These feats as here described are certainly of the most remarkable, distinctly out of the power of Open Science to produce, and we think beyond the scope of the juggler. Thus a picnic was arranged, in the neighbourhood of Simla, at which Mr. and Mrs. Sinnett, Madame Blavatsky, and three other persons were to have been present. A seventh person joined them on setting out, after all the arrangements had been made and the baskets packed. Whilst breakfast was being prepared in the woods it was noticed that there was one cup and saucer too few, and some one laughingly asked Madame Blavatsky to create another cup and saucer. She replied that it would be very difficult, but that she would try. She as usual held mental conversation with the Brothers, and then wandered about within a radius of half-a-dozen to a dozen yards from the spot where the party were sitting. "Then she marked a spot on the ground, and called to one of the gentlemen to bring a knife to dig with. The place chosen was the edge of a little slope, covered with thick weeds and grass and shrubby undergrowth. He—let us call him X—tore up these in the first place with some difficulty, as the roots were tough and closely interlaced. Cutting into the matted roots and earth with the knife, and pulling away the *débris* with his hands, he came at last on the edge of something white, which turned out, as it was completely excavated, to be the required cup. A corresponding saucer was also found after a little more digging. Both objects were in among the roots which spread everywhere through the ground, so that it seemed as if the roots were growing round them. The cup and saucer both corresponded exactly, as regards their pattern, with those that had been brought for the picnic. I may as well add that afterwards, when we got home, my wife questioned our principal khitmutgar as to how many cups and saucers of that particular kind we possessed. In the progress of years, as the set was old, some had been broken, but the man at once said that nine tea-cups were left. When collected and counted that number was found to be right, *without* reckoning the excavated cup. As regards the pattern it was one of a somewhat peculiar kind, bought a good many years previously in London, and which assuredly could never have been matched in Simla."

There are, we submit, only three conceivable ways of accounting for this occurrence. Either—

1. Mr. Sinnett is guilty of deliberate deception, or—
2. He and others present were themselves deceived by an elaborate fraud, or lastly—
3. The cup and saucer were produced in the earth where found by some agency to us inconceivable.

As regards the first alternative, though we have not the pleasure of knowing Mr. Sinnett personally, yet a friend of high scientific standing vouches both for his integrity and for his general acuteness and freedom from gullibility.

The second supposition literally bristles with difficulties. The ground where the cup was found is described as undisturbed. If a tunnel had been dug, through which the cup might have been thrust to the spot where it lay, some traces of such an excavation would have been found when a special search was made shortly after. What is equally important, the need for a cup and saucer could not have been foreseen, since it arose from an unexpected person joining the party at the last moment. Again, the servants, without the knowledge of the guests, chose these particular cups, which were taken from amidst other sets. Besides, there are two roads from Simla to the final destination of the party. Neither Madame Blavatsky nor Col. Olcott had any share in the selection of the one actually taken, and had the other been chosen the party would never have picnicked at that particular spot. Hence, as the facts are presented, the second supposition seems inadmissible, and there remains only the third, startling as it admittedly is. It should be mentioned, as Mr. Sinnett candidly admits, that Mr. X, who dug up the cup, afterwards changed his opinion as to the satisfactory character of the occurrence, and argued that the cup and saucer might have been thrust into their places by means of a tunnel cut from a lower part of the bank.

A variety of other feats are recorded, for which we must refer to Mr. Sinnett's book. The Brothers were further petitioned to give some demonstration of their powers which should be utterly incontrovertible, such as to produce in India a copy of the London "Times" of that day's date. Koot Hoomi, however, pronounced this test inadmissible, precisely because it would close the mouths of the sceptics. Says he—"What are they to expect who would offer the world an innovation which, owing to human ignorance, if believed in will surely be attributed to those dark agencies that two-thirds of humanity believe in and dread as yet. . . . What, then, would be the result of the most astounding phenomena supposing we consented to have them produced? However successful, danger would be growing proportionately with success. Test after test would be required, and would have to be furnished. Your daily remark is that one cannot be expected to believe unless he becomes an eye-witness. Would the lifetime of a man suffice to satisfy the whole world of sceptics, &c." We fully admit that there is a certain force in this reasoning, and we warmly appreciate the spirit of the following passage:—"The public safety is only ensured by our keeping secret the terrible weapons which might otherwise be used against it."

But it seems not to have struck Mr. Sinnett that there are tests of another order far more convincing than "feats," incapable of being mistaken for jugglery, not calculated to arouse popular superstition, not requiring to be seen in order to convince, and which would at once decide whether or no "occultism has been carried in the domain of physical science far beyond the point which we have reached," Suppose the Brotherhood were to say "Point your telescopes to such and such a spot in the heavens, and you will find a planet as yet unknown to you, having such and such elements;" or "Dig into the earth in such a place, and you will find a mineral containing a metal new to your Science; its atomic weight, its specific gravity, &c., are so and so;" or again, "Dig into such other strata on the slope of the Mount X, and you will find the remains of an animal as yet unsuspected and undescribed, and having such or such characteristics." Such or similar proofs, not of superior *power*, but of higher *knowledge*, would not increase any man's facilities for evil-doing. Were even the smallest evidence of this kind vouchsafed we men of Open Science would be glad to recognise the Brotherhood as our masters, and to trust to their teachings. But in the book before us we find not the smallest trace of anything capable of verification. Till some foothold of this kind is given us it is useless to bid us join the Theosophical Society or change our "mode of life." Teachings so indefinite we are compelled to reject, not indeed "superciliously," but sadly.

Koot Hoomi is reported as saying, in proof of the difficulty of communicating any of the knowledge of the Brotherhood to an outsider, "How could the phenomena of our modern electrical science be explained to, say, a Greek philosopher of the days of Ptolemy, were he suddenly recalled to life, with such an unbridged *hiatus* in discovery as would exist between his and our age?" Mr. Sinnett, in his own person, argues in a very similar style in an earlier part of his work.

To both we reply that it is found practicable to explain, if not all the niceties, yet the main outlines, of modern electrical science to schoolboys who at the outset know certainly less of the subject than would the Greek philosopher of the days of Ptolemy!

II. WILL-O'-THE-WISP: A CONFESSION.

NOT often has "dry" Physical Science to deal with the phenomena which figure in folk-lore. Such an exceptional case is afforded by the nocturnal occurrence known to the learned as *Ignis fatuus*, and to the unlearned in different countries as Jack-o'-Lantern, Will-o'-the-Wisp, Wild- (or rather Wold-?) fire, Friar's-Lantern, *Feu Follet*, Heerwisch, &c. The exception deserves the more notice as modern chemistry and physics have by no means succeeded in finding a satisfactory explanation of the facts. Facts they undoubtedly are. The *ignis fatuus*, though by no means common, has still from time to time been observed by competent witnesses, and occasionally by several persons in company. Nor is such evidence disputed: let any man of sober habits and ordinary truthfulness state that he saw a Will-o'-the-Wisp at such and such a time and place, and the most sceptical of our orthodox *savants* will listen with calm interest, and, though he may question the narrator closely as to the circumstances of the case, he will by no means proclaim it *à priori* impossible, or throw out any insinuations concerning "dominant ideas."

If we examine and compare the most recent and trustworthy records of this phenomenon, we find it described as a light which appears in calm, mild nights, chiefly in summer or autumn. It is most commonly observed in swampy or marshy places, or where much organic matter is undergoing decomposition. Dr. Phipson* describes it as most common in England, "in the peaty districts around Port Carlisle, in Cumberland," on the Continent "in the damp valleys between the pretty little university town of Marburg and that of Cassel, and more certainly still in the graveyards outside the town of Gibraltar." The light in question is generally single, though sometimes two wisps are said to have been seen together. It glides or bounds along at a variable speed, sometimes maintaining the same vertical level, but at other times rising, falling, and overleaping hedges, trees, &c., and may often be tracked to a distance of a couple of hundred yards from the spot where it originates, or rather where it is first observed. It is recorded as in many cases moving *towards* a pool or swamp, and there disappearing. The light is said to be sometimes globular, spheroidally elongated, or pear-shaped, about the size of "two fists," and varying in colour and brilliance, being sometimes visible even in the light of a full moon.

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* Familiar Letters on the Mysteries of Nature. London: Sampson Low and Co.

So much for points authenticated by the accordant testimony of trustworthy observers. Popular tradition adds much more. The spectators are said to have sometimes received sudden blows or shocks. According to an old German story, some village children having irritated a Wisp by crying out—

"Heerwisch ho, ho, ho!
Brennnst wie Hafer stroh!"

it pursued them into a house, and stunned every person present by blows with its fiery wings. Folk-lore, indeed, distinctly personifies the Wisp, and ascribes to it the intention to mislead the solitary traveller and entice him into a swamp or pond.* This view or superstition is by no means extinct, as will appear from the following extract from "Light" (June 24th, 1882, p. 296). A contributor of that journal, who uses the *nom de plume* "Miror," gives the following account as narrated to him by an old cottager:—

"'When I was a ploughboy, at Purbeck, I was sent to the blacksmith, who lived some distance off, with some harness to be mended. The blacksmith was at chapel; this delayed the work, and it was not till half-past nine in the evening that I could start for home. It was pitch dark, and as I went along a Jack-o'-Lantern came hopping before me. It was not above the size of your two fists. I was quite aware that Jack-o'-Lanterns came to lead you out of your path, so I kept my foot in the rut all along the country road, till *he*, the Jack-o'-Lantern, hopped over a gate where there was a pond close by, and tried to entice me there.'

"At the above very evident testimony of evil intention the boy was overwhelmed with fright, and taking to his heels rushed, he knew not where, till he came to a house. There they took him in, and one of the inmates accompanied him over the fields, and put him on his way home.

"'I had not gone far,' continued the old man, 'before another Jack-o'-Lantern came hopping before me, and tried to entice me to a swamp which lay on one side of my way;

---

* We cannot help here remarking that mediæval tradition personified certain phases of the nightmare, as the terms Incubus and Succuba sufficiently testify.

but I knew where I was, and went straight for home, half dead with fear. Never again would I go to that blacksmith's of an evening.'

"'If he had not kept his foot in the rut,' broke in the old woman, his wife, 'it might have been all over with him. When a Jack-o'-Lantern gets you in the water, then he sniggers; he laughs, you know. I've heard my father say that scores of times.'

"Thus we see the old woman brought forward the testimony of her father also, with respect to the traditional shady character of the Jack-o'-Lantern, or Will-o'-the-Wisp, or *Ignis fatuus.*

"'You call the Jack-o'-Lantern *he*,' I said. 'You talk as if you thought it knew what it was about; and by luring you into danger it had an object in view, and not a good one.' 'Just so,' said the old man. I said I was inclined to agree with him.

"On the man's assenting to the woman's assertion that 'when a Jack-o'-Lantern gets you into the water, then he laughs,' I pressed the question, 'Do you really mean to say that they are really *heard* to laugh—that they make the noise of laughter?' 'Yes,' was the reply. 'But how,' I rejoined, 'can people know that they laugh when those who are led by them get drowned, and do not live to tell it?'"

It is curious that "Miror" speaks of this his own objection—fatal, as it appears to us—as "rather lame special pleading on my part." It must not be forgotten that the occurrence is said to have taken place at Purbeck. Now in the counties of Dorset and Wilts the tendency to personification is very strong, and the country people speak of many things as "he" which in the Metropolitan District and the Northern Counties are always referred to as "it."

A very full and definite account of the appearance of an *Ignis fatuus* is to be met with in a modern work* reviewed in our current issue. Some passages of Mr. White's narrative we quote. The inhabitants of Itapua, a small town in the La Plata States, situate on the River Parana, were during the author's stay alarmed by "a mysterious light that appeared almost every night in the second plaza, situated on the high river banks, but where, nevertheless, the ground was in some parts a temporary swamp, from the rains settled in the hollows. In this plaza were posted the line soldiers' barracks, and to the guard bivouacking round their fire at night it first manifested itself. My friend Lieut. Morcillo, the officer in command, soon got to hear of it, and, scenting trickery, issued notice that he had given his soldiers orders to fire upon it whenever and wherever it became visible. The soldiers, as they became more accustomed to the *Ignis fatuus*, began to style it the "Plazera." Singular to relate, no sooner did the light burst forth than it was heralded throughout the town by a universal chorus of howls from all the mangy curs in Itapua. In order to elucidate the mystery Lieut. Morcillo and myself visited the plaza for several nights in succession, accompanied by three or four soldiers with loaded rifles and ourselves armed with revolvers. The military were posted round the square, and we waited from 10 o'clock till 12 or 1 in an atmosphere bathed in the brilliancy of a full moon. Only twice was it seen by me, but then very distinctly; the first time some little distance off, but the second quite close. On the first occasion the light started up from the ground with the brightness and speed of a rocket, and then again descended to the earth with equal velocity but less splendour: on the second we caught sight of it as it directly, but gently, approached along the road, upon which, running to intercept it, and stumbling at every step over rough and swampy ground, we managed to arrive within 3 yards of the glowing vision as it slowly glided on at a level of about 5 feet from the earth. It presented a globular form of bluish light, so intense that we could scarcely look at it, but emitted no rays and cast no shadows; and when about actually to grasp the incandescent nothingness, suddenly elongating into a pear-shape tapering to the ground, it instantly vanished; but on looking round up it rose again within 50 yards, but this time we could not overtake it, as it bounded over a hedge, then over trees, and finally disappeared in an impenetrable swamp. According to the testimony of the soldiers, on another occasion, they beheld it rise from the swamp and perch for some minutes on the top of the roof of a neighbouring rancho without walls, after which it pierced the roof and subsided in the ground beneath; but in our case there was no deception, and moreover we noticed that it never appeared on a windy night nor after rain." The author adds, in comment, "Although the marsh-gas theory presented itself to my unwilling mind, it would have to be strained considerably to be able to account for all the attendant circumstances."

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* Cameos from the Silver Land, by E. W. WHITE, F.Z.S. London: Van Voorst. Vol. ii., p. 447.

We will now attempt an examination of the various hypotheses proposed for the explanation of the Wisp.

Trickery may be at once set aside as out of the question.

The movement of the light is totally unlike that of a man carrying a lantern. It is at times much swifter, overleaps objects which a man could not surmount, and plays often over water and at heights of from 20 to 50 feet in the air. Neither can we consider that it is produced by the reflection of a light thrown from some neighbouring house. Fireworks are equally out of the question. Not to speak of the slowly progressive movements of the Wisp sometimes observed, it is in the highest degree improbable that any trickster would convey a quantity of pyrotechnical appliances into solitary moorlands, woods, and peat-bogs, in order to alarm some stray traveller.

Another hypothesis, advanced by certain very learned authors, such as Ray, Willoughby, Kirby, and Spence,—ascribes the Wisp to luminous insects. Dr. Dereham and Dr. Phipson combat this view on the ground that such insects "rise far higher in the air than does the Wisp, and present the appearance of hundreds of little specks of light." This argument seems scarcely valid; luminous insects are in all probability more numerous than is ordinarily supposed, and vary considerably in their habits. Not all are high flyers, nor are they all gregarious. The apparent size of the light may be considered a fatal obstacle, since no known English insect emits a light of the size of "two fists." But a light seen in a dark night by a superstitious and terrified ploughboy will very naturally be described—and that without any conscious or intentional exaggeration—as much larger than it really was. The circumstances that the Wisp is chiefly seen in calm weather and during the summer season are in favour of this supposition. But we have some positive testimony to advance. The Rev. Dr. Sutton, of Norwich, informed Dr. Kirby that when he was curate of Ickleton, in Cambridgeshire, in 1780, a farmer of that place, of the name of Simpringham, brought him a mole-cricket (*Gryllotalpa vulgaris*), and told him that one of his people, seeing a *Jack-o'-Lantern*, struck at it and knocked it down, when it proved to be the insect in question. Mr. Main ("Mag. of Natural History," n. s., i., p. 549) was told by a farmer that he had encountered and knocked down the luminous object, which he described as being exactly like a "maggy longlegs" (*Tipula oleracea*), an insect, we must add, especially abundant in boggy and marshy lands. Dr. Dereham, the opponent of the insect theory ("Phil. Trans.," 1729, p. 204), describes an *Ignis fatuus* which he had personally witnessed as flitting about a thistle—a very likely action for an insect, though very unlikely for a volume of inflammable gas or for an evil spirit. Mr. Sheppard informed Dr. Kirby that when travelling one night from Stamford to Grantham, on the top of a stage-coach, he observed "for more than ten minutes a very large *Ignis fatuus* in the low marshy grounds, which had the same motions as a *Tipula*, flying upwards and downwards, backwards and forwards, sometimes as settled, and sometimes as hovering in the air." It is remarked that in this case the wind was very high, so that a vapour would have been carried forward in a straight line, which was not the case. We are well aware that the insect-theory is not free from difficulties. Thus the question at once arises, Why is this phenomenon so rare? It is also to be asked whether the light given off by insects is sufficiently strong to be visible at such distances as the Wisp is said to have been?

The orthodox theory at the present day—that of spontaneously inflammable gases, hydrogen phosphide, marsh-gas, and possibly hydrocarbons given off by decomposing animal or vegetable matter, is open to even more formidable objections. The presence of the spontaneously inflammable variety of hydrogen phosphide has never yet, we believe, been analytically demonstrated among the gaseous matter given off from marshes, pools, and cemeteries.

In Brande's "Dictionary of Science, Literature, and Art" (ii., p. 191) the Wisp is ascribed to "the issue of marsh-gas from the earth. This gas, being ignited either accidentally or intentionally, continues to burn with a flame sufficiently luminous to be well seen at night." The writer admits, at the same time, that no natural production of spontaneously inflammable gas has ever been observed. Dr. Phipson gets over the difficulty of ignition by assuming that the gas given off consists of marsh-gas through which a small proportion of hydrogen phosphide is diffused. But an emission of inflammable gases from the earth or the water, however ignited and however composed, will not account for the phenomena in the majority of cases on record. In proof of this let anyone perform the simple experiment of stirring up the mud at the bottom of a dirty ditch or pond, and ignite the marsh-gas given off by means, say, of a piece of taper fixed at the end of a fishing-rod. The gas will burn immediately over the surface of the ditch or swamp, but the flame will not travel away for considerable distances, overleaping hedges, stiles, trees, or buildings, or playing over thistles. Further, it is found that the Wisp is most common in calm, fine weather, when the barometer is high. But gases pent up in the soil, in marshes, &c., will be most readily evolved when the barometer is low! Rainy and windy weather is not unfrequently foretokened by the rise of bubbles of gas from the bottom of ponds and marshes. We can readily understand, however, that a light produced by inflammable gas might, if the supply was large and constant, hover over an extensive marsh or graveyard. But in such cases it would not be one and the same portion of luminous matter flitting up and down, but a succession of fresh bubbles, jets, or puffs of gas becoming ignited in turn. This accords ill with the facts as reported by observers; they generally speak of a single continuing light.

Another hypothesis refers the phenomenon to electricity. We always find that the less any person knows about electricity the more easy he finds it to account for any unexplained facts by its agency. Luminous appearances of electric origin are certainly well known such as the "Castor and Pollux," which appears at the extremities of the masts of ships during stormy weather. Similar lights have been noticed, especially in mountainous regions, attaching themselves to umbrellas, lances, alpenstocks, &c. But these phenomena seem essentially distinct from the true *Ignis fatuus*, which, as we have already said, is characteristic of fine weather, and moves about instead of attaching itself to pointed objects.

In all probability several distinct phenomena have been confounded under the name of *Ignis fatuus*, and further careful observation is required for their respective discrimination. Those persons who live in or visit regions where the Wisp occurs might do good service by noting all the circumstances of each case at the earliest possible opportunity. The nature of the soil, the barometric pressure, temperature, the wind, and in short the entire character of the weather, should be recorded, and an attempt should be made to take the spectrum of the light.

It appears that the mediæval and popular notion of the Wisp — a conscious and evil-disposed being—is again brought forward by persons of education. "Miror," whom we have already quoted, whilst accepting the hydrogen phosphide hypothesis, asks further—"May not, however, Spirits of a low and malicious order, bent on mischief, when they find a natural medium in the dark, under circumstances favourable to their malice, make use of this gas, found in marshy places, to suit their purpose? Or may not an evil Spirit, fond of marshy places, have the power to turn an *Ignis fatuus*, that has its rise from natural causes, into a devious course for an evil purpose ?" We reply that there is no satisfactory evidence of purposiveness, good or evil, in the movements of the Wisp.

III. BESTIARIANISM *v.* COMMON SENSE.*

OF all the movements and agitations—religious, moral, social, or political—by which society is at present convulsed the Anti-Vivisection, or, as it is better called, the Bestiarian crusade, must be pronounced the strangest. Strange it appears to be in almost every respect; the object against which it is directed is in its extent utterly insignificant, and to the great mass of the public even non-apparent. The novelist, the lawyer, the dog-fancier, &c., do not witness physiological experiments, do not even read about them, and but for the labours of busybodies would not even be aware of their occurrence.

Further, most "movements," however much they may have been helped forwards by the arts of the rhetorician, have to some extent sound, straightforward arguments at their command. The Bestiarian agitation seems, to us at least, to have relied exclusively upon misrepresentations and inflammatory appeals to popular ignorance,—ignorance as gross often among prelates, statesmen, and peers, as among working men and small shopkeepers. Artfully designed catchwords have been coined. Just as a couple of centuries ago to call a woman a witch was to ensure her destruction, so in our day to pronounce any practice "cruel" is to obtain its unenquiring condemnation. To a foreigner these curious outbursts of extreme humanity in the classical home of pugilism, of wife-beating, and of "sport,"—in the country where cock-fighting is experiencing a revival,—are strangely suggestive. Question-begging epithets, terms left undefined, well-known truths overlooked, arguments systematically ignored have been the very sum and substance of the onslaught upon physiological experimentation. Two national peculiarities have greatly facilitated the task of our enemies. John Bull, in spite of his vaunted common sense and practicality, is especially liable to be thrown into a state of stampedo. Like his four-footed prototype, when the buzz of a gadfly is heard, he gallops over any and everything, and will some time, in one of these fits, break his own neck, which will of course be a case of "magnificent self-abnegation!" And such gadflies are among us fearfully common. We are likewise as a nation apt to listen with devout credulity to persons of rank and "consideration," however little acquaintance they may have with the question at issue.

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* Experimental Physiology, its Benefits to Mankind. By RICHARD OWEN, C.B., M.D., F.R.S., &c. London: Longmans.

The Uselessness of Vivisection upon Animals as a Method of Scientific Research. By LAWSON TAIT, F.R.C.S. Birmingham: Herald Press.

The Ethics of Vivisection. By Dr. S. WILKS. Contemporary Review.

That by these and kindred means "a strong and wide-spread public sentiment" has been created, we do not dispute. But we can have no respect for such sentiment. We can put it on a level only with the hallucinations of a fever-patient or a lunatic. It must indeed be remembered in this connection that insanity in its formal and acknowledged shape is multiplying out of all proportion to the increase of the population. Serjeant Cox calculated that, if the growth of insanity continues at its present rate, we shall have, in another thirty years, a million and a quarter of lunatics in these kingdoms. It may be asked by some-one, What is the bearing of this view upon the question? It is simply this: when in an unhealthy climate, or in a sickly season, the death-rate is high, we may be sure that the amount of disease and debility not proving immediately fatal will be much higher. In like manner, if insanity is augmenting in any country, we may be sure that there will be its increasing penumbra of *semi*-insanity,—of people who though not put under restraint, but allowed to write and make speeches and vote, are not guided by sound reason, but by passion and sentiment. Could we search the Bestiarian ranks we feel confident that we should find multitudes of this class—perhaps, even, some who might with advantage to their own health be put under restraint and due treatment.

Many persons have felt staggered by the fact that a few physicians and surgeons have thrown in their lot with the enemy. The leaders of the movement are obviously aware of the effect which such defections produce upon the public mind, and lose no opportunity of parading such "doctors" at their meetings. We must, however, call the attention of our readers to certain considerations which will solve this apparent anomaly. Though most medical men are, in the true sense of the word, "men of Science," this cannot be predicated of all. There are some who are indifferent to the acquisition of further knowledge concerning the phenomena of life, health, and disease. They do not seek to discover anything. We could name a very able practitioner, a teacher of physiology at one of the most eminent provincial medical schools, who quite ignored and sneered at the microscope. Such men are quite content to go on prescribing or operating as they did on first obtaining their diplomas; and by means of a mysterious, incommunicable tact they may be very successful. But they do not advance medical science by a single hair's breadth. Their style is clever rule-of-thumb.

There is a much lower grade of practitioners who enlist in the Bestiarian ranks. The medical profession is overcrowded. Can we therefore wonder if some, who have little prospect of rising by more legitimate means, seek to avail themselves of the popular mania? To be proclaimed at the tea-tables a "dear nice man," who does not meditate any treason against the *alter ego* of any gossip present; to-wit, her spiteful pampered lap-dog may, in commercial phrase, be "made to pay."

Lower still: there are, we understand, "Doctors" whose names are not to be found in the "Medical Directory," who are brought forward as representatives of enlightened and advanced medical opinion. Whether these worthies possess any registerable qualification, or are merely the holders of bogus diplomas,* and whether they are paid for their appearance on the platform, we can only surmise.

We do not for a moment insinuate that Mr. Lawson Tait belongs to any of these classes. On the contrary, we know him as an investigator whose researches we have had the pleasure of noticing in the "Journal of Science," and of whom we had hoped much better things.

Before entering upon an examination of Mr. Tait's memoir, which is a reprint from the "Transactions of the Birmingham Philosophical Society," we must bring forward two considerations which to us seem to involve the Bestiarian party in an absolutely fatal dilemma. We ask, in the first place, Why should it be less defensible to inflict suffering upon animals, in pursuit of knowledge, than from any other motive or with any other purpose? This question, though it has been put in various forms,* is invariably avoided by the Anti-Vivisectionists. They feel—must feel—that it is an inconsistency, in spite of that well-worn catch-word, "Two blacks do not make one white," of which Lord Chief Justice Coleridge is said to have delivered himself. Let us bring forward a few instances of this inconsistency, that they may be duly valued by the reader, reminding him first that almost every conceivable experiment upon a vertebrate animal, whether involving bodily lesion or not, may be construed as an infraction of the Vivisection Act.

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* Within half a mile of the place where we sit writing resides, or lately resided, a worthy who for a consideration in money will procure for any applicant degrees in any faculty, or, for the matter of that, an order of knighthood or a title of nobility.

Two men, for a wager, flay some frogs alive, and sprinkle salt upon their bodies "to see which would jump the farthest." The magistrate before whom they are brought dismisses the case as not coming within the scope of the law, remarking, however, gravely, that had the operation been performed for a scientific purpose the defendants would have been liable to heavy penalties.

A boy impales a frog on a fish-hook as a bait for pike, and leaves it to writhe and struggle all night in the water. He also has broken no law, nor has he "violated public sentiment." But if he, in an unlucky hour, feels disposed to watch the circulation of the blood in the web of a frog's foot, and ties this member down so as to admit of its inspection under a microscope, he has then incurred the risk of a heavy fine, and has indulged in an "Orgy of Diabolism."

Yet again: an angler hooks a salmon, and "plays" it for (say) an hour.† All this while the victim has been suffering from slow suffocation. The hook fixed in the mouth will also have been the cause of something more than mere inconvenience. All this prolonged "torture" is, however, perfectly legal, and the angler, after enjoying his favourite pastime, may indulge in Bestiarian harangues, no man twitting him with hypocrisy! But suppose that, in order to study the vital conditions of fishes, whether from an abstract or an economical point of view, he places oceanic species (say) in an aquarium filled with brackish water; he is then guilty of vivisection, and all its pains and penalties, legal and social, fall upon his devoted head.

Further, we have seen Buckinghamshire farm-boys drench a newt with petroleum, and set it on fire. For this there is no legal penalty, and our mild remonstrance was met with an actual volley of choice rhetoric and a promised one of mud and stones. But did we take a brood of newts, and endeavour, by gradually modifying their surroundings, to convert them in a series of generations into a terrestrial form, we should be at the mercy of the enemies of research, and might at any time undergo a prosecution made purposely as expensive as possible.

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* See Prof. Owen's work, p. 37; also "Journal of Science" for 1876, p. 318.

† We have heard of cases where a vigorous fish has struggled for a longer time.

Any man may keep a cobra, and may, if he likes, feed it upon guinea-pigs or young rabbits. So far he is perfectly safe; he may even take pleasure in watching the death-struggles of the victims. But if he, before throwing a guinea-pig to the cobra, administers to it some supposed preservative and notes the result, or if he takes away the bitten creature and tries in any way to cure it, or if he seeks in any manner to derive instruction from its death, he will be hauled before the magistrate.

One more instance of this nature, and we must pass on: rats and mice are viewed in the light of convicted criminals, liable to execution. Everyone who finds them on his premises may shoot, crush, drown, or poison them. If he prefers to use poison, he is at full liberty to select aconitine. But if he gives a mouse, condemned as it is, some unknown drug with a view to test its action, or if, in order to confirm the results of chemical examination, he introduces into its body a portion of matter extracted from the remains of a person supposed to be poisoned, directly every "scribbler draws his penknife blade," every stump-orator waxes red in the face with vociferation, and each hysterical lady dog-fancier shrieks out maledictions!

If any of our readers is a Bestiarian—Anti-Vivisectionists do not greatly love this appellation—we would ask him whether he is prepared to justify these inconsistencies, all, be it remembered, the natural outcome of the Vivisection Act, and of the agitation by which it has been obtained and is sought to be extended? Can he, or can any man, seriously maintain that the higher the motive the worse the action? Can he deny that such instances as those given above are grossly inconsistent? To the miserable quirk about "two blacks" we reply with the adage that they who dwell in glass houses should beware of throwing stones. Or, quoting a higher authority than Chief Justice Coleridge, we say—"Thou hypocrite, cast out first the beam out of thine own eye, and then shalt thou see clearly to pull out the mote that is in thy brother's eye."

A vast majority of Bestiarians think it perfectly legitimate to inflict pain upon animals with their own hands or vicariously for a number of objects,—*i.e.*, for food, or for such commercial products as hides, horns, hair, furs, oils, &c; in compelling animals to serve their purposes for labour; in rendering them more submissive by emasculation, for amusement, and for self-defence. As regards the last head all mankind are agreed, save a portion of the Hindoos and certain of their imitators at home. Concerning the former objects, which in the aggregate cause the infliction of a millionfold the torment which results from physiological experimentation, we ask how are our opponents to get over this difficulty? To do them justice they rarely make the attempt; they meet our argument with the conspiracy of silence. They go on ranting about the "cruelties" of physiology, but ignore the greater cruelties of gourmandism, of luxury, of ostentation, and of sport. The "Zoophilist," the organ of the Victoria Street clique, as Prof. Owen well says, "offers no protest against the skinning alive of eels, or the boiling alive of lobsters, shrimps, and winkles." Elsewhere he writes—"The tender-hearted, who howl down the infliction of a slight wound on a single deer, have no remonstrances in favour of the hundreds of the dappled herd which undergo the terrors of the chase, the wounds of the stalker's bullet, and the cutting of the throat to supply the appetite and please the palate of the gourmand." They say substantially "Venison we must have; we can do without information."

The common plea of our opponents, when they condescend to justify their inconsistency, is that of necessity. We utterly reject this plea. "Sport" in all its varied meanings, wherever the word applies to the infliction of pain, terror, coercion, and death upon animals, for the sake of man's recreation, is not necessary. Furs, feathers, silk, even leather, can be dispensed with. Animal food, however agreeable and wholesome, is not essential to man's existence. Millions of our species live in health and vigour without its use. Beasts of burden and of draught might probably be superseded in this age of mechanical invention, at least in settled countries where the roads are good. However this may be, that large proportion of horses which serve merely for sport, for luxury, ostentation, and convenience might be dispensed with. Nor, again, is castration a necessity. Dr. Wilks well says—"One might ask in these sentimental and æsthetic days whether one sigh of pity has ever been raised for these poor maimed creatures?" We understand that but for an accident the Vivisection Act would have been so worded as to include this piece of unscientific vivisection.

Great would have been the confusion among Bestiarian peers and prelates had the slip not been detected.

Here, then, we have the two pictures. On the one hand, millions upon millions of creatures subject to pain and bondage, often for a lifetime, to gratify man's greed and luxury, Bestiarian prophets and Mænads looking on without feeling "sick at heart." On the other is a vanishing number of animals subjected to pain in the pursuit of knowledge, and here the Prophets and Mænads burst into frantic outcries. They then suddenly think that we "have no right to torture the creatures of God for the sake of any supposed benefit we might derive from doing so." They strain at the gnat after swallowing the camel. Did we not know man's power of self-deception, especially when under the influence of fanaticism, we might pronounce Bestiarians—with the exception of such as, like Mrs. A. Kingsford, M.D., strive to be consistent—the most amazing hypocrites that the world has ever known.

(To be continued.)

IV. EVOLUTION BY SEGREGATION.

IT is now generally conceded by those whose previous studies have made them able to decide, that Evolution, broadly speaking, must be accepted as the mode in which organic species, as we see them, have come to exist. But in what manner this process of Evolution has been effected, what is its cause, and what are its laws of action are still very open questions. The theory of Natural Selection, as originally put forward by Darwin and by Mr. A. R. Wallace, is certainly not gaining ground. Not to speak of the arguments brought against it by Prof. St. George Mivart,* within the last few years it has become almost a truism that before Selection of any kind can come into play there must be varieties among which to select. It is also contended that the struggle for existence—the reality and intensity of which no one seeks to deny—must tend, in the main, to lessen rather than to augment the multiplicity of animal and vegetable forms. Hence it will be rather a negative than a positive factor in the origin of species, not so much favouring the origin of new varieties as eliminating those—*ex hypothesi* the majority—which are not in harmony with their surroundings.

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* Genesis of Species.

We may even venture to infer that the variety and richness of any flora or fauna will be inversely as the severity of the struggle for existence. This is no mere supposition, since wherever that struggle is intensified by man, whether through his own direct agency or through his introduction into any region or island of foreign plants or animals, the immediate result is the extirpation of a number of the indigenous species, and the diminution to that extent of the total number of organic forms present on the globe. An instance of this kind, in California, is noted and commented on by Dr. Behr,* in these words :—"Our original vegetation has very little power of resistance. Its *very variation* is a proof of a certain want of vitality, for any more vigorous organisation, by superseding the weaker ones, would have produced originally the monotony developed at present by the immigration of foreign plants." "Species," says Mr. Wallace, "can arise only where there is room for them." This passage is, we submit, a substantial admission that variation is greatest where natural selection is least active. Instances of a similar kind to that in California are but too plentiful.

The aboriginal flora of St. Helena has been substantially extirpated by the introduction of the goat, the pig, the rat, and the rabbit, conjointly with certain European weeds. Similar causes are at work in Mauritius and its adjacent islands, in the Galapagos, &c., and even in such extensive regions as the Cape, Australia, and La Plata the native flora is being impoverished by the very same cause. The aboriginal birds of the Sandwich Islands will, in another half century, be known only from stuffed specimens and from plates.

On the other hand, we never find, so far, that this intensification of the struggle for existence has led to the formation of any new species, better qualified than the original types to cope with or evade the intruders. The only changes in this direction which we perceive are modifications of habits, in accordance with new or increased dangers, as has repeatedly been observed in the more populous parts of the United States.

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* California Rural Press.

The theory of Natural Selection being thus open to doubt under a variety of aspects, we may venture to call the attention of our readers to a hypothesis which, in England at least, has scarcely received the attention it deserves,—the doctrine of Evolution by Segregation, or, as it might be otherwise expressed, by isolation in space. According to this theory, the less the members of a species are crowded or pressed upon—whether by other species or by members of their own—the more likely they will be to strike out into variations which become permanent as good species. Segregation, as well as Natural Selection, presupposes a tendency to vary, whether from internal or external causes, but, as we shall have to show, it throws more light both upon the origin of such varieties and on their preservation. In most other respects the two principles are directly hostile, Segregation ascribing the origin of species to the absence rather than to the abundance of competition between individual and individual, or between form and form.

It has been repeatedly urged, and even presented in a mathematical form, that if, among a numerous species inhabiting one common region, there arises spontaneously some modification which gives its possessor an advantage over its fellows, there is a very slender probability of such variation being transmitted unimpaired, not to say increased, to the next and succeeding generations. Whether the modification is superiority in speed, or in strength, or the possession of a colour favourable to concealment, it is almost a matter of certainty that in the course of a few years, by successive pairings with individuals of the ordinary type, it must become obliterated. Nor is this a mere theoretical supposition which breaks down in actual life. Experiments have been made to improve the half-wild cattle and horses of the pampas of La Plata, and of the llanos of Venezuela, by the introduction of superior Andalusian bulls and English and Arab stallions. But the results prove that a minority of individuals, whatever may be their physical superiority or their other advantages, if mixed with a vast majority of individuals of the common type, and freely interbreeding with them, can effect no permanent modification of the race. In these experiments no natural selection occurred, though the struggle for existence was manifested under the most favourable conditions.

But let us suppose that among the animals of a certain species inhabiting a given region a few stray away from the ordinary haunts of their kind, or, in a word, emigrate. It may well happen, as Herr Wagner suggests, that individual animals which vary somewhat from the majority of their species will suffer persecution, and will therefore be relatively more likely to emigrate. Among such individuals—exposed as they probably would be to a change of climate, of soil, of food, of outward conditions in general—variations would be much more likely to occur than among the original stock who remain under the same conditions as their forefathers. It is true we have got very much to learn concerning the influence of external circumstances upon animal and vegetable life. But, as has been shown by Semper in his interesting work,* this influence is not unimportant. Not merely are variations more likely to arise among a small body of emigrants than among the main stock, but those which do occur are likely to be perpetuated in the exact proportion of the fewness of the colonists, and in proportion also as free communication between these colonists and the mother-race is rare or difficult.

This assumption of the formation of species by isolation is supported, as Herr Moritz Wagner (not to be confounded with the Bestiarian, Musikant Wagner) shows at length, by the facts of animal geography. There is no point in Tropical America where all, or even the majority, of its species of humming-birds can be found together. Many of them are confined each to a single mountain, to a certain altitude on that mountain, to a deep *quebrada* or gorge in the Andes, or to one bank of a river.

In many other extensive groups the various species are found occupying adjacent islands or separate portions of a continent, like the links of a chain or the meshes of a net, bordering on or slightly overlapping each other, but not coextensive. Or when different species of a group occupy a territory in common, they appear still to have distinct head-quarters, and are comparatively rare in others. Of this distribution a very familiar instance may be seen in the English beetles of the genus *Carabus*. These insects are all alike in their requirements and their habits; they feed on the same prey, and have in all parts of England the same enemies to contend with. Nor do they meet with any marked diversities of climate in the different parts of the island.

Yet among the common species we find a great and marked inequality of distribution. *Carabus monilis*, which in the South of England is perhaps the most plentiful of the whole genus, fades away northwards. In Yorkshire it is scarce, and in Lancashire quite a rarity. On the other hand,

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* Animal Life as affected by the Natural Conditions of Existence.

C. granulatus is in Lancashire the commonest Carab, but is comparatively rare in the south. Farther north *C. glabratus* becomes exceedingly abundant. It would be hard to point out, after a careful survey of these insects, what advantage the differences of colour and sculpture between one and another of these insects can be in the struggle for existence, —especially as they prey in the night or in the early morning twilight,—and hence their origin, either in England or on the European continent, can with difficulty be traced to natural selection.

Among the chief evidences of the Darwinian doctrine are the phenomena of Mimetism, which have been so ably observed and described by Bates, Belt, and others. It is often found that certain animals, especially insects, closely resemble the colour and the texture of the leaves, flowers, bark of trees, sand, and other objects, animate or inanimate, among which they lurk. Such resemblances enable some creatures to escape the quest of their enemies, whilst other species in the same manner deceive their intended prey. About the facts in question there is no dispute. Before the publication of the "Origin of Species" they had not escaped the notice of naturalists, and, as Herr Wagner tells us, they were the subject of frequent discussion. The Darwinian explanation of the phenomena is perfectly familiar. It is supposed that creatures which were, from their colour and make, easily recognisable, being in contrast with the colour of their habitat, were, unless otherwise protected, sifted out, —gradually eliminated. Those which closely resembled the foliage among which they lived, or the earth on which they crept, escaped and perpetuated their species. Let us take the case of a sandy desert where every creature, as the Rev. Canon Tristram informs us, is "desert-coloured." No one can deny that a red or a brown insect would be more easily recognised by insectivorous birds than if it had been of a stone- or a dull fawn-colour; and supposing one out of a brood of its descendants departed from the heretofore normal colour of its race, and approached the universal fawn-tint of the locality, it would, *pro tanto*, be more likely to escape its enemies and to survive. Hence it is assumed that by degrees the entire population of a desert would have a colouration in harmony with the general tone of the scene.

If the colours and shapes of animals have been modified on this principle, then the facts of mimetism or "mimicry" must be recognised as forming a powerful argument in favour of the formation of species by the process of natural selection. Herr Moritz Wagner, however, explains the phenomena of mimicry on a quite different principle. He considers that insects and other animals consciously and intentionally seek out lairs and places of abode the colouration of which may agree with their own. Thus if the fauna of the Sahara is of a desert-colour, it is because animals having such a colouration have emigrated thither from the southern slopes of the Atlas, or from the northern regions of the Soudan, and finding themselves in harmony with their new domicile have established themselves there permanently. If the Arctic territories have a number of white forms, in agreement with the snowy colour of their surface, it is not because from a former many-coloured fauna all species not white have been gradually eliminated, but because white species have taken refuge there. The agreement between the colour of an animal and that of its locality is therefore dependent upon the will of the former.

In examining this explanation of mimetism we must begin by fully admitting that animals are known, especially when in danger, to seek hiding-places which agree in colour with their own. Such facts have not unfrequently been observed in aquaria, where small Crustacea, Cephalopods, &c., have been seen to place themselves with wonderful accuracy on a stone or other object closely resembling themselves, and where any spectator not forewarned would scarcely detect their presence. In some cases even assumptions of colour have been observed, in accordance with that of neighbouring objects. The attitudes of butterflies are sometimes intentionally—it would seem—deceptive. The "browns," when resting on the ground with wings erect, let the upper pair sink down between the lower till the spots of the underside are concealed, and then "heel over" so as closely to resemble a withered leaf resting slightly a-tilt.

It is perfectly true that animals purposely and knowingly have recourse to mimetic stratagems to deceive their prey. The tiger and the leopard, in India, are found to imitate most closely the whistling cry of certain species of deer, which are their favourite prey. But there are points in mimetism which Herr Wagner's hypothesis cannot, as far as we see, be fully made to meet. Let us take the case of the mimetic bug (*Spiniger luteicornis*), described and figured by our late lamented friend Thomas Belt.* This insect mimics not merely in colour, but in the movements of its wings and antennæ, a large hornet (*Priocnemis*), and doubtless finds its advantage in so doing. This resemblance we can to some extent comprehend on the theory of Natural Selection. But we can scarcely admit that the bug has set out on its travels to search for some more powerful insect for which it might be mistaken, and having recognised such a one in the *Priocnemis* has taken up its abode in localities inhabited by the latter. Or, to take a somewhat similar case, the caterpillar of the lobster-moth (*Stauropus fagi*) has in some of its attitudes a very decided resemblance to a spider, and might easily be mistaken for one when lurking among leaves. Ichneumons have for the most part a great dread of spiders, and it is hence exceedingly probable that such a resemblance may save these larvæ from the attacks of their chief enemy. It is here exceedingly difficult to explain this mimicry by emigration. In every country where the food-plant of the larva—the beech tree—grows, spiders are present. Whence, then, can the insect have come in search of a formidable something which it resembles ? The change of its food-plant would not affect the question at all. Very many indeed of the mimetic features of insects seem inexplicable upon the migration theory.

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* Naturalist in Nicaragua, p. 319.

As regards "desert-forms" of life there is also a difficulty. Canon Tristram observes that the fauna of Arabia is more thoroughly desert-coloured than that of the Sahara, and hence draws the very plausible conclusion that the Arabian deserts are the older, the fauna of the Sahara not having yet had sufficient time to become adapted to its surroundings. This difference between the faunæ of the two deserts seems to us in harmony rather with the hypothesis of Darwin than with that of Herr Wagner,—with the supposition of selection rather than with that of immigration.

On attempting to summarise the considerations put forward above, it seems to us that Segregation is more likely to favour the establishment of new species than is Selection, which latter appears to be actually reducing the number of existing forms. Segregation also can more readily take into account the influence of those external agencies which must, occasionally at least, exert a transforming power upon organic species. On the other hand, Herr Wagner's explanation of the phenomena of mimetism seems very questionable.

Can the two theories be reconciled ? We doubt it, although Prof. Semper is of opinion that Segregation is included in Darwinism. It must be admitted that the struggle for existence may often prove the cause which impels individuals of a species to emigrate, and thus an indirect harmony may be established between the two theories. In their direct aspects, however, they are diametrically opposite.

V. THE HORSE AND HIS FOSSIL ANCESTRY.

ONE of the most striking pieces of palæontological evidence in favour of Evolution is well known as being presented by the fossil Equidæ. Not wishing to reiterate at length familiar facts, we will merely sum up the peculiarities of this group of animals by saying that *Orohippus*, the earliest known genus of this family, had its fore feet 4-toed, the representative of the thumb being alone wanting, though the middle digit is much larger than the others. Its hind feet were 3-toed. The remains of this species are found in the Eocene deposits of North America.

In the Miocene Tertiaries occur three genera, all 3-toed on both fore and hind feet. One of these (*Mesohippus*) has, however, on the fore feet a rudiment which represents a fourth toe, though it is useless. In *Miohippus* this rudimental fourth toe has disappeared, but the three toes are not strikingly unequal in size, and all of them touch the ground and take part in the functions of a foot. We go a step further: in *Ancitherium* the foot has still three toes, all touching the ground, but the middle one is much larger than the two outer toes put together. All still touch the ground, though the functional importance of the outer digits must have been but trifling.

Another step lands us in the Upper Miocene and the Lower Pliocene. Here occur the remains of another genus, *Hipparion*. Here, though there are still three toes, the two outer cannot touch the ground, and the middle one alone is to be called active.

In the later Pliocene formation we find the fossil skeleton of *Pliohippus* with a foot exactly like that of the *Equus*, the modern horse, which does not appear until the Post-Pliocene. In both these genera there is merely one perfect toe, which is enclosed in a single hoof. The two side toes which we traced in *Ancitherium* and *Hipparion* are now represented by rudiments, known technically as splint-bones.

If we lay these forms side by side, in what may be called chronological order, we cannot deny that there is here a gradual series of changes, departing more and more widely from the typical 5-toed foot of the Mammalia, and approaching nearer and nearer to the structure of the most recent form of the family, the still living horse.

The general, and we may say the natural, inference drawn from these fossils is, that we have here an instance of those gradual changes of animal forms by which, on Evolutionist principles, existing animal "species"—if we may use the word—have been produced.

But this interpretation of the facts is not universally conceded. There are those who contend that though we have never found an *Ancitherium* in the Eocene, a *Hipparion* in the earlier Miocene, a *Pliohippus* in the earlier Pliocene, or an *Equus* in the later Pliocene, yet it is not impossible but that a further examination of the geological record may disclose the remains of such,—that, in a word, these various forms may have been not successive, but contemporary. The probability is of course exceedingly slender, but the advocates of independent mechanical creation may, if so disposed, claim that it should be taken into consideration.

There is yet a further supposition which has been advanced. Admitting, argue some, that these various forms existed, not simultaneously, but in succession, *Ancitherium* having disappeared before—*e.g.*—*Hipparion* came into being, there is still no positive proof that the later forms are descended from the earlier. They may conceivably have sprung into existence independently of each other, the earlier kinds dying out and the later being created in their room. Whatever we may think of the probability of this hypothesis, like the former it is not impossible, and must be fairly met.

It is therefore fortunate that certain recent researches in which Herr A. Nehring has taken a prominent part, and which he has summarised in a paper read before the Berlin Gesellschaft Naturforschender Freunde ("Sitzungsbericht," 1882, No. 4, p. 47), throw an additional and welcome light upon the question.

In the course of the changes which we have just been tracing in the hands and feet* of the Equidæ, it is not only the fingers and toes, and the bones best known as those of the wrist and ankle, which have been gradually reduced in number. Corresponding modifications have taken place in the bones of the fore arm and of the leg. The outer bones of both, the ulna and the fibula, have undergone a corresponding degradation or retrograde development. In *Ancitherium* we find the ulna in proportion strongly developed. The fibula, however, is decidedly weak, and its lower part is applied closely to the inner bone, or tibia ; but it is still a complete and connected bone.

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* It is convenient to speak of the anterior extremities of a mammal as hands, whether they have any power of grasping or not.

In *Hipparion* the process of degenerative change is more advanced. The ulna is so much reduced in the lower part of its central portion, and so closely joined together with the fully developed radius or inner bone of the fore arm, that it is no longer capable of free motion, though it still appears as a complete and connected portion of the skeleton. As regards the hind legs, the fibula of *Hipparion* is interrupted in the middle, and consists of an upper and a lower part no longer connected together.

As we approach more recent times, we find the same changes proceeding further. The ulna of the true modern horse is in its middle portion greatly reduced, and even interrupted, and is connected with the radius in young animals by means of sinews, and in old ones by bony growths.

Now so far it might still be contended, concerning these modifications of the fore arm and of the leg, that they supply no absolute proof of "descent with modification." But sometimes in recent horses and asses we meet with a case of a complete and uninterrupted ulna, just as it occurred in *Hipparion.* Herr Nehring, in proof of this assertion, exhibited to his audience the fore-arm bones of a horse of the Cleveland breed and of an adult ass. These specimens showed that in *Equus caballus*, as well as in *E. asinus*, the ulna is sometimes so far developed as to take the form of the ulna of *Hipparion.* Such cases are more common in the horses of heavy breeds than in such of slighter frame : they are also more common in the ass, which seems to represent a more primitive type among the recent Equidæ.

As for the fibula it is so degraded in the recent horse as to consist merely of a rudimentary portion above, and a lower joint-piece which intimately attached to the tibia. Sometimes, however, as in the Cleveland horse above mentioned, the fibula, though not complete, has the interval between its upper and lower remnants much smaller than in the majority of horses,—not larger, indeed, than it is found in *Hipparion.*

According to Mr. Steel, in the ass complete uninterrupted fibulæ sometimes occur.

Those who deny the descent of the modern horse and ass from the fossil Equidæ are obliged to pronounce these re-appearances of ancient types mere unmeaning individual variations,—in other words, *lusus Naturæ*,—and are thus driven to a contention of questionable legitimacy.

To the Evolutionist these departures from the normal type of the horse and the ass are cases of atavism,—reversions to an ancestral structure,—and afford therefore the evidence which connects the recent Equidæ with their fossil progenitors. It will be felt that modifications of the form of certain parts of the skeleton cannot be suddenly, and at one stroke, introduced in all the members of a species or of a genus, but they are established by degrees. Whilst the majority of individuals have already adopted a given change in form, others will be occasionally met with which adhere to the earlier form, and yield but slowly to the existing tendency to variation.

VI. ON TECHNICAL EDUCATION.

By Robert Galloway, M.R.I.A.

(Continued from page 412.)

TO cursory thinkers on the subject of Education it may appear surprising that the middle class, as a class, have not long ago demanded the establishment of public schools in at least some of our important centres of commerce and manufactures, which would provide as suitable an education for their sons as Eton, Harrow, and our other great public schools provide for the sons of the nobility and the wealthy class. Why should the one class be supplied with an education which it is considered is the most suitable to qualify them to discharge most efficiently their duties in after life, and the other class be left unprovided with an education which would be the most suitable to advance them in their future careers in life?

Many causes have operated in preventing the demand being made. The many do not know what to require; hence they are content with the prevailing fashion in education, for all teaching is to them alike: they cannot distinguish good teaching from bad, nor have they the means of testing whether the education that is being given to their children does or does not train their mental powers. Not knowing, therefore, the kind of education to demand, they are content to allow their children to be as imperfectly educated for their after pursuits in life as they were themselves. This is especially the case with those who have been successful in business; they think the kind of education they received will do equally well for their children, neglecting to perceive the fierce struggle England is entering upon, both in commerce and manufactures, with America and other civilised nations, and the ever-increasing care these countries are bestowing in providing an education suitable for the wants of their middle classes. They have (especially the Germans) their Mercantile Public Schools: the object of these schools is to provide a suitable education for those who intend to devote themselves to a purely commercial career, as bankers, book-keepers, merchants, accountants, clerks, correspondents, &c. Instruction is given in mercantile science, in mercantile law, political economy, book-keeping, correspondence, mercantile arithmetic, chemical and mechanical technology, mercantile geography, history, arithmetic, geometry, German, French, English, and free-hand drawing. In some mercantile centres, such as Hamburg and Bremen, no boy intended for commerce—not even the son of the richest banker—is excepted from the system of training they have established for young merchants. Well might the Right Hon. W. E. Forster, M.P., say, speaking from experience, that a young German who had to make his way in the world as a clerk had a much better chance than a young Englishman,—not because he was naturally quicker, but because, in consequence of the German system, he had received a much better education to fit him for business. Mr. Forster has had the advantage of a twofold experience: he has not only been engaged in commerce, but he has also been Vice-President of our Education Department. They have also their Real Public Schools. The object of these schools is to provide a suitable education for those intended for manufacturing pursuits: the education given in this class of schools is based on the natural sciences and modern languages, as against classics in their classical schools.

Having their elementary schools, their classical schools, their real schools, their mercantile schools, &c.,—in short, schools suitable for the wants of each class of society,—they are of course far in advance of the English with respect to education; but their school system possesses another advantage over ours, if we can be said to have a school system at all, which is even still more important: their system is a graduated or progressive one; from the rudimentary lessons given in the elementary schools to the highest teaching given in their technical colleges or universities, it is on an ascending scale of instruction; a student cannot pass from a lower to a higher course, as I have shown in a former article is and can be done in this country, unless he is fitted to take advantage of that higher course of instruction. There is in consequence a completeness in every stage of education, each school perfecting its pupils in the branches of education it gives: the pupils, when they pass to the next higher school, have not therefore to commence to relearn the subjects they were taught in the lower one, as is too commonly the case in this country.

This admirable system of education, which has been developed and so successfully carried out in Germany, has been framed, as Mr. Perry states in his article on German Schools,* by a succession of *able statesmen and scholars*, and is modified and expanded from time to time in accordance with the wants of the age.

Although the many do not know what kind of education to demand, a reaction has nevertheless set in against a purely classical training, and this reaction is not confined to the middle classes; the dissatisfied are being propitiated by the introduction of one or more of the natural sciences and the modern languages into the ancient course of studies, even in schools like Eton and Harrow. It is desirable, no doubt, to modernise in part the system hitherto pursued in classical schools; but this by no means does away with the necessity of establishing mercantile and manufacturing schools corresponding to those on the Continent. For to attempt to teach in the same school courses of instruction suitable for those intended for professional life, and for those intended for commerce and manufactures, would end in the ruin of the classical system, and would likewise fail in establishing a good system of modern education.

The amalgamation of the old and the new, and the attempt to make the course of school studies suitable for the wants of all classes, must end in bringing the whole system of education into a chaotic state. "It is easy," Mr. Perry well remarks, " for educational reformers to draw up an enticing plan of study, including the whole field of human knowledge ; but the practical teacher knows how little is gained by making a thousand shallow scratches on a pupil's mind, which only confuse and erase each other,—knows that, if you would bring living water from the depths of his nature, you must sink one deep shaft at least."

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* Macmillan's Magazine, 1877.

That we are entering upon a struggle with other nations more severe than has previously occurred all facts and figures go to prove. Mr. Mulhall remarks, in his " Balance Sheet of the World"—" In 1880 the industries of Great Britain attained a point never before reached in this or any other country, *but if we compare the progress made during the decade we shall find it was less* than in the interval from 1860 to 1870, and much less than in the United States during the ten years now under consideration. *But although this is probably the last time that Great Britain will occupy the highest rank in the industrial nations of mankind*, there is no symptom of decline, no diminution in force or energy to cause us any anxiety. . . . There is but one industry, agriculture, in which we have lost ground, the advance of all the rest being so great that the aggregate for 1880 shows an increase of 337 millions sterling. . . . Commerce has not risen so much as in the previous decade, . . . nor does mining show the same advance. Manufactures have grown less than any other branch of national increase. . . . Banking and shipping exhibit an enormous development. This," he observes, " is the more remarkable, as the balance of trade against Great Britain has increased in a degree that some economists consider alarming, viz.—

	Millions Sterling.	
	1870.	1880.
Imports	305	414
Exports	242	278
Surplus imports ...	63	136

Thus the balance of trade against us was 25 per cent in 1870, and 49 per cent in 1880. This is, however, rather an indication," he states, " of prosperity than the reverse, since we see that until 1840 our exports were more than our imports ; and Russia and Spain have the balance in their favour, and are steeped in poverty."

It does not follow that because Russia and Spain have the balance of trade in their favour, and are nevertheless steeped in poverty, that it is an indication of our prosperity that the balance is largely against us. No just comparison, in my opinion, can be instituted between the three countries; they are unlike in all essential conditions,—unlike in race, unlike in industrial resources, and in almost every commercial and manufacturing aspect.

The United States are more exactly comparable—whether as regards race, raw materials, commerce, or manufactures—with England than the countries Mr. Mulhall has selected for comparison. And the balance of trade is now in her favour: the exports were 31 per cent in 1880 over her imports. The consumption of raw material in that country rose 404 million lbs. against 468 millions in Great Britain; but the United States grew 95 per cent of theirs, whilst we had to import 93 per cent of all consumed in our factories. The manufacture of iron and steel has increased enormously in that country: the Americans now make one-fifth of the iron, and one-fourth of the steel of the world. The actual increase of American industry in the decade was 525 millions, whereas the maximum among European nations, that of Great Britain, was only 337 millions. And we had a national debt in 1880 amounting to 774 millions sterling, or £22 9*s*. ratio per inhabitant; whilst in the same year America had a national debt amounting to £390,100,000, or £7 13*s*. ratio per inhabitant. And our national and local expenditure has increased during the last decade 20 per cent, and our national expenditure increases yearly by an enormous sum. Well might the Chancellor of the Exchequer, the Right Hon. Wm. Ewart Gladstone, heave a deep sigh, and wish there were now some Joseph Humes in the House of Commons to assist in checking these enormous yearly increases, when he had to announce that he estimated that the national expenditure this year would be eighty-five and a half millions.

America has adopted free trade for agricultural produce, and will continue it, as she has nothing to fear from any other country in that branch of production; but it is all but certain she will continue to be a protectionist, as regards manufactured goods, until she feels she has attained that perfection in this branch of industry that will enable her to compete with us successfully both in quality and price, and in this she is supported in her view, to a certain extent, by that late eminent practical economist John Stuart Mill. He states, in his "Principles of Political Economy," under the head of "Protection to Native Industry,"—"The only case in which, on mere principles of political economy, protecting duties can be defensible, is when they are imposed temporarily (especially in a young and rising nation) *in hopes* *of neutralising a foreign industry,* in itself perfectly suitable to the circumstances of the country. *The superiority of one country over another in a branch of production often arises only from having begun it sooner.* There may be no inherent advantage on one part, or disadvantage on the other, but only a present superiority of acquired skill and experience. A country which has this skill and experience yet to acquire may, in other respects, be better adapted to the production than those which were earlier in the field; and besides, it is a just remark of Mr. Rae that nothing has a greater tendency to promote improvements in any branch of production than its trial under a new set of conditions. *But it cannot be expected that individuals should at their own risk, or rather to their certain loss, introduce a new manufacture, and bear the burden of carrying it on until the producers have been educated up to the level of those with whom the processes are traditional. A protecting duty,* continued for a reasonable time, will sometimes be the least inconvenient mode in which the nation can tax itself for the support of such an experiment. But the protection should be confined to cases in which there is good ground of assurance that the industry which it fosters will after a time be able to dispense with it; nor should the domestic producers even be allowed to expect that it will be continued to them beyond the time necessary for a fair trial of what they are capable of accomplishing."

But whether supported by political economists or not, it seems all but certain that America and continental nations will continue to protect all their important manufacturing industries until they can equal or surpass us in price and quality in our own market, notwithstanding all the advice we may give them to follow our example. Success, they may say, in anything is always attended with more or less sacrifice at the start; and they may also reply, in the language of Prof. Goldwin Smith, slightly altered, that many of your so-called Free Traders are nothing of the kind,—you are merely advocates of a particular tariff, very wisely framed, no doubt, with reference to British industries and interests, but not necessarily suited to those of all the countries in the world. You have had, they may say, men, like Cobden and Bright, who did thoroughly understand the meaning of the principle; but with the rank and file of the movement Free Trade has meant nothing but an alteration of the tariff in their own favour. And they might point to the petition of the Lancashire mill-owners against the import duty the Indian Government levied on cotton goods, when it began to affect their interests; and the subsequent tax imposed on the long-stapled cotton, though it was requisite for the Indian cotton-spinners to import for the purpose of mixing with the short-stapled native, in order that they might compete successfully with the English cotton goods, as very inconsistent with free-trade principles.

My object in bringing prominently forward statistics, both as regards English and American prosperity, is with the view of impressing upon our commercial, manufacturing, and trading classes, that they, especially, ought no longer to be satisfied with the present system of public education in this country. Our manufacturers especially have too long been content only to know somewhat of the commercial part of their business, and little or nothing of their craft; but even as regards buying I have shown in my work on Scientific and Technical Education, by remarkable examples,—and I could add to them,—that they are frequently unable to buy with advantage from this non-acquaintance with their industry; and the cry that is arising for apprenticeship schools arises from this very fact—our manufacturers being no longer practically acquainted with their industries, but being simply capitalists and employers of labour; whilst the manufacturers on the Continent, owing to the education they have received in their Real Schools and in their Technical Colleges, are entering on their duties with a full knowledge of them, and are, by the excellent education they have received, exercising a marked influence on the development of their manufactures.

VII. SAFETY REJECTED.

AGAIN, as in a long succession of seasons, we have been entertained with high hopes, almost amounting to prophecies, of something at least approximating to a summer. Surely, it has been generally felt and said, after so many ungenial years—either moist and cold beyond the average, or at least affording us dry calm weather only when least needed—we might, on the mere probability of the matter, hope for weather not utterly ruinous to the farmer and the gardener. The cycle of hard winters which set in with 1878-79 seemed over, and the easterly winds during the spring months were less persistent than usual. Consequently vegetation was unusually advanced, and the appearance both of the field-crops and of fruit-trees was promising. April, however, was colder than the average, and since then the character of the year has declined. The months of June and July must rank among the most unseasonable on record. The temperature has been low, the winds high, the rainfall excessive, the skies generally cloudy by day and clear by night, thus cutting off the earth from the rays of the sun, and allowing it to become chilled by unchecked nocturnal radiation. The hay-harvest has been disastrous, and in many parts of the kingdom must prove an entire failure. Without a speedy change, of which there is little apparent prospect, the wheat will fare no better, whilst in many districts the potatoes are already rotting from excess of moisture and from lack of heat.

We recapitulate these sad facts, not in the spirit of Pessimism, not exulting in the discomfiture of the weather-prophets and of the irrigationists, who in such seasons must surely find their avocation gone, but for the sake of pointing out the consequences of our national rejection of the remedy which is ready to our hands.

Last autumn it seemed as if the drying machine of Mr. W. A. Gibbs, after its successful action had been demonstrated on a practical scale for so many years, was about to meet with general adoption. This consummation has been "blocked" in a most curious and unexpected manner. A Mr. Neison has come forward with a rival scheme, which he asserts he has developed seven years ago, but which he has only made public within the last twelve months. This scheme offers the advantage of immediate, or at least apparent, cheapness, and thus naturally appeals to classes so depleted as the farmers, and indeed the landowners, must be after the recent succession of disastrous seasons.

We are, of course, far from maintaining that the apparatus of Mr. Gibbs is incapable of improvement. The inventor himself entertains no such notion, for, till lately at least, he has been busily and successfully engaged in improving his machinery from the points of efficiency, economy, and durability. It is, however, quite conceivable that some person might see a method of distributing hot air through the hay, corn, &c., to be dried, more effectual than anything as yet suggested.

Mr. Neison, however, as we understand him, moves in another direction. He proposes altogether to dispense with the coke or anthracite fire used by Mr. Gibbs, and with the machinery for working the hay about in the stream of hot air (see "Journal of Science for 1881, pp. 572, 573). By so doing he effects an apparent economy. But what does he substitute? We cannot obtain power in any shape for nothing. To dry a wet material we must do one of two things: we must either expose it to an increased temperature or to a current of dry air. In a fine season we get one, sometimes both, of these agents for nothing, and need merely expose the material in thin layers to the sun and wind, as in common hay-making. Mr. Neison, instead either of sun-heat or furnace-heat, makes use of a source which persons who, like the majority of farmers, are unacquainted with physical science may possibly consider as cheap as the action of the sun and wind. He builds up his stacks, as we understand, with grass containing its natural moisture, and perhaps soaked in addition with rain. Fermentation sets in, heat is generated, and, as is generally known, without some special arrangement the stack would take fire, as often happens. But to prevent this danger Mr. Neison arranges pipes or channels in the stack through which the heated air is to escape, carrying off the moisture with it, and thus ultimately and in some fashion drying the hay.

In how far this device is novel we cannot pretend to decide. It is not, we understand, protected by letters patent, and some of its advocates have had the questionable taste to sneer at Mr. Gibbs for having taken out patents for his inventions. But, unless our memory completely deceives us, we remember some forty years ago seeing it suggested in an old book, that, when hay has to be stacked in an imperfectly dry condition, a long sack should be first stuffed full of hay or straw, and set upright. Around this sack the stack was to be built. When it had reached its full height the sack was to be drawn out, thus leaving a chimney through which the heated air and vapours might escape.

Again, Mr. J. W. Thomas, F.C.S., published in 1878 a work entitled "A Treatise on Coal, Mine-gases, and Ventilation," in which arrangements for keeping down the temperature of hay- and corn-stacks by means of pipes are described and figured.

However, the question is not so much the novelty and originality of Mr. Neison's device as its efficiency. No one doubts that if we pile up a large heap of vegetable matter in a wet state fermentation sets in, and a very considerable heat is generated. Such instances as hot-beds, the "firing" of ground dye-woods if too damp, the spontaneous ignition of cotton-waste, &c., are perfectly familiar, and the rise in temperature in beer-worts and wine-must during fermentation is fully known. But the heat thus produced is no more obtained for nothing than is the heat of a furnace. The process that takes place in such heaps of wet vegetable matter is slow combustion ; the carbon and hydrogen of the hay, &c., combine with oxygen to form carbonic acid and watery vapour, and the heat generated is in proportion to the quantity of matter destroyed. It may therefore be said that Mr. Neison dries one part of a stack of hay with the heat generated by burning another portion. Now not only men of Science, but manufacturers of all classes are of opinion that heat may be obtained more cheaply by burning coal than by burning hay or straw. Were it otherwise we should find them buying hay for fuel!

But the case is really worse than if a certain portion of the hay had been taken and burnt in a furnace, in order to dry the rest by means of the heat thus produced. Hay is a complex material, and if it is allowed to ferment—or, in other words, partially to rot—some of its constituents are destroyed more readily than others. The woody fibre, or cellulose, which forms, so to speak, the skeleton or framework of the stalks and leaves of the grass, is scarcely attacked at all. But this cellulose is precisely the least valuable part of grass or hay for the food of cattle. It is but very sparingly digestible, so that the greater part of the dung of cows. &c., is composed of cellulose, ground up into a fine fibrous pulp, but not dissolved.

On the other hand, the sugary matter naturally present in grass, which renders the hay agreeable to the taste of cattle, and which has a considerable nutritive value, is the first ingredient to be destroyed in fermentation. Its oxidation or combustion—for the two words are in such cases practically convertible—is the source of the heat which in the Neison process is to volatilise the moisture present and dry the hay. After the sugar the starchy matter, the albumenoids, and, in short, all the valuable constituents are successively destroyed, and there remains, if the fermentation is only allowed to go on long enough, the woody fibre above mentioned. Instead, therefore, of utilising this heat of fermentation for drying vegetable matters, it should be rendered impossible by at once depriving them of moisture. This is done by Nature when hay is made in dry, sunny weather, with a gentle wind. Such hay retains its colour, its odour, its taste, and its chemical composition, and is, in fact, grass deprived of the greater part of its natural moisture. The same end is obtained still more perfectly by the use of Mr. Gibbs's drying apparatus. But if fermentation is allowed to be set up the nature of the grass is seriously altered. Its colour and odour are changed, and its chemical composition and nutritive value suffer likewise.

There is another point to be considered: in what may be called natural hay-making the cut grass in a loose open state is continually spread out to the sun and wind, so that every part of it is equally dried. Still more perfectly is this done in the Gibbs process, where the grass is tossed backwards and forwards in a kind of shower, in a current of hot, dry, air. But if we first make up the grass into a stack in the wet state, no matter what air-ducts we introduce and what heat we may apply, it is a physical impossibility for the whole mass to be perfectly and equally dried. One part of such a compact mass might be at a temperature bordering upon redness, whilst a few inches off another portion may still be quite wet.

As a practical and decisive test of the merits of the two systems we may refer to a case which was described in our issue for October last year (p. 572), where a stack of hay had been fired by an incendiary, and partly destroyed. The residue was tainted with the smell of smoke and soaked in water, so that cattle refused to touch it; yet this apparently worthless refuse, after passing through the Gibbs drying machine, came out not merely dry, but completely freed from the smell of fire, and was then readily eaten by cattle. We strongly doubt if any such result could be attained by Mr. Neison's system, or by any process of stack-cooling.

We admit that the machine is too costly for many farmers. But we do not see why—like steam-ploughs, &c.—it might not be let out on hire. It has been repeatedly proved that the working cost of the Gibbs machine is a mere trifle in comparison with the saving effected. The question as between the two systems is not one of practical agriculture, but of physics and chemistry, and if "Agricola" had been better versed in these disciplines he would have come to a very different conclusion.

ANALYSES OF BOOKS.

Cameos from the Silver Land ; or the Experiences of a Young Naturalist in the Argentine Republic. By E. W. White, F.Z.S. Vol. II. London : Van Voorst.

In this volume, as in the former (see p. 161 of our present volume), there is the fullest evidence that the author has visited spots of the highest interest to the naturalist, whatever may be his particular department. We see, further, that Mr. White is well able to identify the various animal and vegetable forms which he has encountered. A few passages also prove that he is by no means deficient in the gift of observation. Indeed, we can only account for the comparative lack of original notes on the peculiarities of the Argentine fauna by the supposition that the author has reserved the cream of his experiences for another work, or for memoirs to be laid before some learned society, and is giving us in the present volumes merely a popular survey of his travels.

We learn that the water of the Rio Negro, a tributary of the Uruguay is impregnated with sarsaparilla from the roots of the plants with which the banks are lined. This locality for sarsaparilla is not yet known to commerce.

The description of Paysandu, of ox-tongue celebrity, is somewhat sickening, and may furnish a text for our vegetarian epopts. We notice that the scandalous custom of feeding swine on the offal of the slaughtered oxen prevails here. Hence pork is generally eschewed as an article of diet. The blood, mixed with the intestines is kiln-dried, and converted into manure. Such a rude process must infallibly occasion a grievous nuisance, and deteriorate the value of the product. All the blood does not, however, seem to be utilised, as "bloody streams are seen vomiting their contents to incarnadine the pure bosom of the Uruguay." The description of an island in the Uruguay, near the Montevidean shore, is enough to make the fingers of the naturalist tingle. An island in the same river is described as "rich in splendid agates, blocks of rock crystal, amethysts, and other precious stones." At Salto the author "was surprised to find whole walls built of nothing but fine agates, many of which weighed 25 lbs., and from whose crevices I picked with a penknife good specimens of rock-crystal ; the whole district is strewn with amethysts, garnets, chalcedony, and cornelians." There are also water-worn nodules of carbonate of lime "completely enclosing water, so that they can be shaken about like a Toricellian hammer, the whole being beautifully translucent, and very plainly exhibiting the imprisoned liquid, which is said to be extremely poisonous." The "musical boom" of the *Rhea*, or American ostrich (species not named), is said to be strikingly characteristic, even when heard at the distance of half a mile. A species of cactus (*Tricomaria usilla*) has spines a foot in length. It seems, indeed, as if the vegetation of the southern hemisphere, alike in Australia, South Africa, and La Plata is pre-eminently given to the development of thorns.

In speaking of the now decayed town of Rioja, the author makes the following remark, which is capable of much wider extension: "Politics have been the bane of Rioja, as of most other Argentine towns, especially capitals." Where agitation thrives, not merely discovery and invention, but manufactures and commerce, languish, as we have had ample opportunity of witnessing of late years nearer home.

The following instances of skill, if they occurred in a "dumb" animal, would be pronounced marvellous instincts, and might become the theme of much eloquent sophistry: "These men"—the Rastreadores of Rioja—"will enter a field in the middle of a pitch dark night, and out of a troop of strange loose mules, unerringly lasso their own and march them off, distinguishing those that occupy their several places in the team. Although I have had considerable experience, I never could detect by what sense they were guided."

The people of Rioja, we are told, "have a great horror of bees, and allow no hives within leagues of the city, affirming that they destroy both fruit and flowers, especially of the grapes and oranges." The author calls this an "ordinance based upon ignorance," and so, according to our knowledge, it seems. But we should like to know the origin of this strange notion, and upon what facts, or supposed facts, it has been built.

On the way to Chilecito, Mr. White mentions the humming-birds, "one gifted with song, and others with a distinct whistle." It is to be regretted that he has not mentioned the species, most of the family, as he remarks, uttering merely a shrill chirp. The indigenous ferns of this district he pronounces very similar to those of Europe. The silver mines of Chilecito, if worked with capital and skill, would be unequalled in the world. "Innumerable lodes in the schist yield every form in which that precious metal occurs; fine specimens of native, ruby, and horn silver continually occur, and the rotten quartz, so easily worked, is the teeming matrix of gold." In the Famatina range "lies a tract of about 200 square miles containing hundreds of mines yielding gold, silver, copper, tin, and bismuth, and it is a curious fact that those of gold are always found beneath, and the copper at the top." In these mining districts, bleak and bare, Mr. White saw abundance of mountain doves in pairs, of the exact colour of the rocks, and many very rich and rare humming-birds, which, as he had no fowling-piece with him, he was unable to capture and determine. Near Catamarca is the southern limit of the fire-tail humming-bird (*Sparganura sappho*). The author considers *Chrysotis amazonica*, a green, red, and yellow parrot, to be capable of a higher education than the well-known grey African species (*Psittacus erythacus*).

It is curious that in the upper provinces of La Plata, though intermittent fever (Chuchu) is common, there is a deeply-rooted prejudice against the use of quinine, which the natives consider rapidly destroys the coats of the stomach. Mr. White, like not a few eye-witnesses, both in La Plata and other regions, not forgetting our own colonies, notes with regret that English manufacturers do not push their interests as they might, and that our goods are thus losing ground, not from inferiority of quality or higher cost. This apathy in face of the frantic efforts made to oust us from the markets of the world is something remarkable.

At Tucuman goitre is very common, affecting about one-half per cent of the natives. It is said to indicate metallic ores, and in those districts where it is most severe limestone does not occur. The railway from Tucuman to Cordova passes over the so-called Salinas, sometimes a plain of glittering salt, but, when Mr. White passed, covered with water, and tenanted by red flamingoes in hundreds of thousands.

At Singuil the condors commit dreadful havoc among cattle in spite of the war waged against them with bullet and poison. In the neighbourhood of Andalgala the vines are standards and yield very heavy crops of fruit. Here the author was in want of small shot, and being desirous of capturing some of the smaller *Trochilidæ* he tried sand and rice. The former stunned the bird but destroyed the plumage, whilst rice broke up in the discharge. The attempt to secure the birds by means of arsenical syrup introduced into flowers met with very little success. Most of the species detected the danger, though a *Patagona gigas* imbibed the poison, became immediately ill, vomited, and was found dead the next morning.

In the neighbourhood of the Aconquija range a peculiar disease attacks strange mules. Animals reared in the district and men generally are exempt from its ravages. A dry and clear air neutralises the virus, but in damp weather or rain the animals are seized with trembling, succeeded by violent convulsions, which quickly prove fatal. The cause of this strange affection is unknown.

At Colalao every seven years a flood of sand and mud descends down the small river, covers the land, and even invades the houses to the depth of seven or eight feet.

The *Leuconerpes candidus*, a species of woodpecker, goes about in families, and passes up a tree from the root to the very top of the stem in corkscrew fashion in a single slow-moving file, each head touching the preceding tail.

Irrigation-canals, however useful in regions where moisture is deficient, are here, as elsewhere, a source of malaria. In the province of Salta, the real original potato, a small reddish tuber no larger than a walnut, is still in use. A curious instance is given of the ferocity of the peccary. A man, in order to escape a herd of these fierce little swine, climbed up a good-sized tree, leaving his horse tied to the foot. His friends found afterwards that the brutes had not only attacked and devoured the horse, but had uprooted the tree, and made a meal of him also!

The falls of the Parana exceed the much-vaunted Niagara. That of Iguazu is calculated at 174 to 180 feet perpendicular, whilst Niagara is only 144. The width of the Iguazu is a thousand yards, and its volume of water enormous. The Guaira fall is much larger still!

In closing our survey of this work we must pronounce the second volume much more important and interesting than its predecessor. It gives an excellent picture of the capabilities of the La Plata regions, and will, we hope, tempt further explorers to a region whose fauna and flora are scarcely even known in the rudest outline.

A Manual of the Infusoria. Including a description of all known Flagellate, Ciliata, and Tentaculiferous Protozoa, British and Foreign, and an account of the Organisation and Affinities of the Sponges. By W. SAVILLE KENT, F.L.S., F.Z.S., F.R.M.S. 3 Volumes, pp. 913, 51 Plates. London: David Bogue, 1880—1882.

THIS magnificent work will probably disappoint those microcopists who have been accustomed to a convenient arrangement by which all minute inhabitants of fresh or salt water have been spoken of as Infusoria, a heterogeneous group including not only the Infusoria proper, but various Rhizopoda, Rotifera, and even Acari, besides numerous vegetable organisms, such as the Diatomaceæ, Desmidiæ, and other Algæ. Although such classification, or rather want of it, may bring together those forms most sought after by the pond hunting microscopist, it is somewhat bewildering to the student who wishes to do more than merely name the specimens which come under his notice. He will here, for the first time in any English work, find the Infusoria proper brought together in an accessible form. Limited, as they now are, to a small section of the sub-kingdom, Protozoa, the number of species is surprising, no less than 51 plates, each containing numerous figures, being required to delineate the various forms described in the book.

The introductory part of the work fills more than two hundred pages, and not the least interesting portion consists of the early history of the subject. This, as may be supposed, is intimately connected with the invention and improvement of the microscope, brought into public notice about the year 1619. Nearly fifty years later we find the first account of any attempt at minute scientific investigation in Dr. Robert Hooke's "Micrographia Illustrata." The discovery of the minute organic beings, especially treated on in this work, belongs to Antony van Leeuwenhoek, whose first observations were published in the "Philosophical Transactions," vol. xii., No. 133, for the year 1677, under the following title: "Observations communicated to the publisher by Mr. Antony van Leeuwenhoek, in a Dutch letter of the 9th of October, 1676, here Englished, concerning Little Animals observed in Rain, Well, Sea, and Snow Water, as also in Water wherein Pepper had been Infused." Part of Observation I. may be quoted for the sake of giving a specimen of the old Dutchman's quaint style:

"In the year 1675 I discovered living creatures in rain water which had stood but four days in a new earthen pot, glased blew within. This invited me to view this water with great attention, especially those little animals appearing to me ten thousand times less than those represented by Mons. Swammerdam, and by him called water-fleas or water-lice, which may be perceived in the water with the naked eye. The first sort by me discovered in the said water, I divers times observed to consist of 5, 6, 7, or 8 clear globules, without being able to discover any film that held them together, or contained them. When these *animalculæ*, or living atoms, did move, they put forth two little horns, continually moving themselves; the place between these two horns was flat, though the rest of the body was roundish, sharpening a little towards the end, where they had a tayle, near four times the length of the whole body, of the thickness (by my microscope) of a spider's web, at the end of which appear'd a globul, of the bigness of one of those which made up the body, which tayl I could not perceive, even in very clear water, to be moved by them. These little creatures, if they chanced to light upon the least filament or string, or other such particle, of which there are many in the water, especially after it hath stood some days, they stook entangled therein, extending their body in a long round, and striving to disentangle their tayle; whereby it came to pass, that their whole body kept back towards the globul of the tayle, which then rolled together serpent-like, and after the manner of copper or iron wire that, having been wound about a stick and unwound again, retains those windings and turnings. This motion of extension and contraction continued awhile, and I have seen several hundreds of these poor little creatures, within the space of a grain of gross sand, lie clustered together in a few filaments."

This description agrees with that of one of the species of Vorticella, the "*two little horns*" being the optical expression of the cilia imperfectly seen.

Then follow the observations of Sir E. King, 1693; John Harris and Stephen Gray, 1696; Henry Baker, 1742—1751; and M. F. Ledermuller and O. F. Muller, to whom we are indebted for the first attempt to classify these minute organisms. In the long interval between the publication of Muller's "Animalcula Infusoria," and the appearance of Ehrenberg's world-famed treatise, a considerable number of investigators occupied themselves in the study of these minute organisms. In 1838 the result of fourteen years' study, entitled "Die Infusionsthierchen als Volkommene Organismen," appeared, a work which even now ranks as classical. The imperfection of Ehrenberg's optical appliances led him to attribute to these minute organisms a far more complex structure than they have since been found to possess. Their very simple organisation was first noted by Dujardin, in 1841, and from that period to the present time, owing to the successive improvements of the microscope, and the increased diligence of observers, one discovery has followed another in quick succession.

The five succeeding chapters are devoted to introductory matter, the second containing an account of the sub-kingdom, Protozoa, and the next the Nature and Organisation of the Infusoria; this chapter concludes with some valuable information as to the mode in which the microscopical observations are to be conducted. As must be expected, numerous difficulties are encountered in carrying on observations with the very high powers needed in examining some of the more minute forms. Mr. Kent remarks that the thinnest cover glass made is inconvenient on account of its extreme brittleness and rigidity, and hampers progress in a most provoking manner, and materially restricts the limits of clear vision. The author, as a substitute uses very thin films of talc, which for perfect evenness and transparency will compare favourably with the finest manufactured glass. With the employment of these talc-films the investigation of Infusoria with the 1-16th, 1-25th, or even the 1-50th inch objectives becomes a comparatively easy task. The material in question possesses the further advantage of bending readily, and permitting the object-glass to be brought close down on the more remote objects in the microscopic field, while it may be cut with scissors to any required size or shape.

A description and figure is given of the moist slide employed by Messrs. Dallinger and Drysdale in prolonged observations, and also the way of making use of it.

It would hardly be supposed possible to preserve permanently so delicate an organism as an infusorial animalcule; nevertheless, this has in many instances been successfully accomplished. Osmic acid is the reagent which has been found most effectual.

Applied either in the form of vapour, or as a solution, of strength of from 1 to 2 per cent, in distilled water, the results attained are most remarkable. All structures, such as cilia, cirrhi, and flagella, the internal endoblast, and in *Euglena* and its allies, the colours also are preserved, the animalculæ, excepting for the absence of motion, being scarcely distinguishable from the living organisms. The author has found the most effectual and simple way of applying the osmic acid to be that of placing a drop on the cover before laying it on the slide containing the Infusoria. A saturated solution of potassic iodide in distilled water, saturated with iodine, and diluted to a brown sherry colour, has been found by the author to act in a manner almost identical with that of osmic acid, and in some instances even more efficiently, and possesses the additional advantage of yielding no deleterious exhalations, which have to be carefully guarded against in the use of osmic acid.

The fourth chapter is devoted to a very exhaustive account of the vexed subject of spontaneous generation. No justice can be done in a mere abstract ; full details are given of the elaborate experiments of Tyndall and Messrs. Dallinger and Drysdale, and the apparatus employed described and figured. As an instance of the almost universal distribution of infusorial germs, Mr. Kent's account of the examination of some grass may be cited :

"On Saturday, October 10th, 1879, a day of intense fog, the author gathered grass, saturated with dew, from the Regent's Park Gardens, the Regent's Park, and the lawn of the Zoological Gardens, and submitted it to microscopical examination, without the addition of any supplementary liquid medium. In every drop of water examined, squeezed from the grass, or obtained by its simple application to the glass slide, animalculæ, in their most active condition, were found to be literally swarming, the material derived from each of the several named localities yielding, notwithstanding their close proximity, a conspicuous diversity of types [here follows a list of several species of Infusoria, also two rotifers, and various diatoms, &c.], the collection as a whole being undistinguishable from the ordinary microscopic fauna of a roadside pond."

The data elicited through the observatious just recorded carry with them an important and far-reaching significance. In addition to the conclusive proof herewith afforded of the primary origin of germs in hay, Infusoria and other minute forms of aquatic life were thereby demonstrated to possess an area of active vital distribution hitherto undreamt of. Water, in its stable and concrete form, is no longer, as hitherto presumed, a requisite concomitant of such vital energy. The smooth-shaven lawn, park-land, and meadow, are each and all one vast teeming city peopled by its myriads of tiny inhabitants, heedlessly crushed under foot in our daily walks abroad. Securely housed in their spore-membranes or encystments, these microscopic beings slumber undisturbed and unconsciously throughout the dry, dusty summer days, awaiting, however, only the fall of the evening dew or passing shower, to cast off the frail cerements that enclose them, and to re-awake to active sentient life. The concluding paragraph of this splendid chapter is so very suggestive, that no excuse is needed for its quotation:

"One final though indirect result of the rigid scrutiny to which the monads and other low unicellular organisms have been submitted, in order to solve the mystery of their generation, remains to be recorded. As conclusively proved by Professors Tyndall, Dallinger, and Drysdale, Cohn, Kühne, and other investigators, such organisms in their germinal or sporular state can successfully resist exposure to temperatures that prove fatal to any other more highly organised structures, even up to and beyond the boiling-point of water. So far, therefore, as they are brought in contact with the ordinary conditions of the earth's surface, they are practically *indestructable.* Nay, more! as suggested by Prof. Tyndall, there is no reasonable pretext for assuming that there are not germs capable of resisting far higher temperatures than those which have been hitherto subjected to experiment. Hence, among all known organic forms, the infusoria and their allies alone would appear to possess the power of weathering the cataclysmic changes of the universe, and, secure from all influences of heat and cold, of migrating in safety through interplanetary space."

The sixth chapter on classification commences with an account of the first attempt at arrangement by O. F. Muller, in 1786. It is founded on the appearances presented by the limited optical appliances of the time, the leading distinction being the absence or possession of external organs. After deducting various Rotiferæ, &c., and low vegetable organisms, about two hundred species of true Infusoria are described.

Ehrenberg's system depends mainly upon the supposed existence of one or many digestive cavities, or their absence, the structure of the infusoria being supposed by this great observer to be far more complex than more recent observations have proved it to be, after eliminating as before, other forms, about three hundred and fifty species remain. These systems of classification are given in full, as are those of Dujardin, Siebold, Perty, Claparède and Lachmann, and Diesing and Stein.

The author's investigations with high powers among some of the forms of Flagellata, and the discovery of some peculiarities about the oral region, have led to very great alterations in the system of classification adopted in the description of the various species. The three divisions which follow, containing a systematic description of the Infusoria, occupy by far the greater portion of the work, and beside the technical matter of the diagnosis, habitat, &c., gives as much information as can be obtained about each species, in very many cases embodying the author's own observations.

The plates cannot be too highly commended, and are accompanied by very full explanations. The work concludes with an Appendix containing a notice of species recorded during the period of publication, a copious index, and, what is of very great importance to the student, a carefully compiled glossary of the technical terms employed. There will also be found a chronological list of works and papers relating to the Infusoria, from the period of their first discovery, in 1675, to the date of publication.

That the present work is final is certainly not maintained by Mr. Kent, who rather looks upon the matter brought together as making a new starting-point for investigation: vast though the progress has been, much remains to be done; many forms may prove to be only larval conditions when the whole of their life-history comes to be known. With the number of students and workers with the microscope many new forms will no doubt be hereafter discovered, and greatly enlarge the number already known, of which the present book includes about nine hundred.

Irenicon No. 2. *Faith: the Life Root of Science, Philosophy, Ethics, and Religion.* By H. GRIFFITH, F.G.S. London: Elliot Stock.

WE have here a work which, if extending in one direction at least to regions beyond our official competence, has for us not the less a very important aspect. The man of Science and the cultured outsider may possibly not feel bound to accept all the author's contentions. Not the less, however, they will find it wholesome to follow him in his survey of the postulates which underlie our received systems. It is somewhat strange, and to our mind not quite satisfactory, that these postulates should be so completely overlooked.

In our elementary treatises on astronomy, physics, chemistry, biology, the student is told of certain fundamental facts, which he is shown how to verify, to connect, and to explain. But he is not told that underneath these primary facts lies a stratum of assumptions, for nothing else can it be called. And it too often happens that the finished, graduated master ignores what the school-boy has never learned. The old geometrician places his postulates at the beginning of his work. Why should not his example be followed? But of this hereafter.

Mr. Griffith's object is to vindicate the position and the authority of Faith by proving it equally necessary to the existence of Science as to that of Religion. With this purpose in view he begins his task with an historical introduction, tracing human progress to ideas, "theories crystallized into palpable facts." He insists on the importance of acquainting ourselves accurately with the vicissitudes of public opinion. Creeds—and we presume the author does not here mean religious beliefs only —are "normal growths, not loose, independent occurrences to be chronicled like the items of an auctioneer's catalogue. Let a system of belief be ever so false or absurd, to speak of it as an outburst of mere caprice" is a misinterpretation. "Call it a weed, if you like, but remember even the most noxious weeds require roots and appropriate pabulum no less than the choicest flowers." At the same time it must be admitted that many beliefs and "movements," ancient and modern, are distinctly pathological—normal only in so far forth as like a cancer or a carbuncle they are not uncaused.

Mr. Griffith, proceeding with his survey of the history of opinions, has a good word for the Alexandrian School, though fully admitting that it produced "no standard original works in Science." He does not appear to share the recent, and as it seems to us well-grounded, scepticism concerning the destruction of the Alexandrian library by the Islamite conquerors. We suspect that the worthy Bishop Cyril and his monks had left little of scientific value to be destroyed.

Mr. Griffith's views on one of the burning questions of the day are given in the following masterly passage:—"All my individual proclivities are in favour of liberty. But that confession notwithstanding I can find no possible room for doubt in regard to the broad declaration that Mind no less than Matter is subject to definite law. A thought or emotion, absolutely self-evolved and self-sustained, is nothing short of an absolute self-contradiction. We have still much to learn on these points, perhaps also not a little to unlearn, before we arrive at anything like logical consistency. Happily freaks, exceptions, abnormalisms, *lusus Naturæ*, and all ideas of the kind have long since been banished from Philosophy. It is full time to get as cleanly rid of them in Theology. It they have any meaning at all it must be an essentially Godless one, however veiled in Scripture phraseology."

Mr. Griffith, in commenting on the fact that we cannot help having the notion of causality, and that our inability to point out the cause of any given phenomenon is no proof of its lawlessness, takes the illustration of an observer seated on the top of a coach and looking down one side at two of the wheels. "Precisely because the said wheels are actually running the same way, each on its own centre, they must appear to him to be turning in exactly opposite directions, though to outside spectators it is clear that all the said wheels are working in obedience to one common impulse." Hence he asks:—"May there not in this strangely composite world be a thousand other seeming contradictories which a change of position on our part would instantly reconcile, and perhaps convert into obvious concurrences." We are here reminded of some interesting speculations put forward by Mr. W. Crookes, F.R.S., in a memoir on "Gravitation as a Factor in the Organic World,"* in which he shows that our perceptions of external nature and our modes of interpreting phenomena are to a very great degree modified by our size.

Mr. Griffith also suggests that "time has difficult problems of its own, perhaps still more formidable than those of space." He continues:—"There are yet other cases innumerable where the antecedent and the consequent appear to run on such essentially different planes, that no common data are left us for determining the relation in which they stand to each other." The illustration which he selects is not in our opinion either well-chosen or well handled, as it would be easy to show did space permit.

As to alleged apparent suspension or modifications of forces, he writes, "Our very definition of a miracle throws it at once entirely outside the domain of Science—not in the least as invalidating, superseding, or amending any previously existing laws, but as springing from the orderly co-working of certain higher and more comprehensive laws, the full meaning or value of which it is beyond the power of human language to express.

Our author comes now to a consideration of the "Principles and Method of Induction," in which as also in other portions of his little work, he criticises justly—and therefore severely—the illusory system known as "positivism," or "Comtism." Whilst recognising the value, or rather the necessity of Induction, he points out that the utmost discrimination is required in arguing from the few to the many. As to the Comtean canon of confining ourselves strictly to phenomena, he owns that "speculation (in the philosophic, not in the gambling sense of the term) has its dangers, but not to speculate at all is simply not to think, or, in other words, not to be worthy of being called men." He further contends and shows by examples that absolute perfection of observation is unattainable. "As all our sensations are reactions of mind subsequent to long successions of intermediate material changes it is manifest we never can see any event exactly at the right time, or any object in its right place or its right size."

Treating of the deductive process which the author recognises as virtually identified with induction in all successful investigation, the two being the "systole and diastole of logic," he argues that, to end in knowledge, pupils have to begin in faith. Thus:—"To determine not to proceed with arithmetic until you have demonstrated or have had demonstrated to you the validity of all its primary assumptions, would be wilfully to foreclose the possibility of ever making way in the science of numbers."

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* Journal of Science, 1879, p. 45.

A further contention, and one of very grave importance, is that "not only in beginning a course of physical inquiry, but in every stage of it we have to walk, by faith quite as much as by sight." In support of this declaration, a number of striking instances are given. "A philosophy restricted to one's own experience could be nothing better than a volume of travels by Simon Stylites." Even Darwin could not dispense with the observations and experiments of others, and was in consequence beholden to testimony.

But here comes an important consideration which the author has overlooked, and which, as far as we can call to mind, has not met elsewhere with due attention. Testimony in Science, and testimony, *e.g.*, in history, do not by any means stand upon the same footing. On the contrary, they differ in an important, if not the most important, respect. This will appear from the following illustration. We read, say in the *Comptes Rendus*, that Thalen has examined a newly discovered metal, and has found in its spectrum such and such characteristic lines. Why do we accept his testimony? Not merely because we know him as a skilful, thoroughly-competent spectroscopist, and as a man of unquestioned integrity who could, moreover, have no intelligible motive for falsifying or suppressing his observations. We receive his account of the spectrum because it is open to others to test and check his results. We know that others will have already done so, and we are well aware that Thalen himself has worked under the full expectation of such a revision. Hence he will have been equally on his guard against deceiving himself or attempting to deceive others.

With testimony in history this is not the case. We cannot send anyone up the stream of time to verify the statements of old chroniclers, or of monumental inscriptions and hieroglyphics. Testimony in Science is like a guide who, showing us round some palace, should throw open door after door, and whilst telling us the contents of each room, should give us the opportunity to examine for ourselves.

Historical testimony, on the other hand, is like a guide who, whilst describing the various rooms, should bid us take his word, as the keys were lost.

One postulate which must be granted, in faith as a preliminary to our scientific studies, the author does not bring into full relief. We refer to the necessity of assuming, without the possibility of ever proving, that the impressions made upon our senses are accurate or at least comparable pictures of an objective world.

We cannot, however, follow Mr. Griffith any further. Dissenting as we must from the Teleology which makes so prominent a figure in his fifth and sixth chapters, and which we believe merely strengthens the hands of the school of thinkers which he is opposing, we have not space to enter upon the prolonged criticism which it would require. The work as a whole has given us no small pleasure, and we recognise in the author, not merely a man of great and unusual learning, but what is of more importance a powerful and original thinker.

Proceedings of the Bristol Naturalists' Society. New Series. Vol. III. Part 3 (1881-2). Bristol: James Fawn and Son.

This issue contains a very considerable amount of sound valuable matter, and certainly indicates no falling off in the activity of the Society.

Mr. F. F. Tuckett and Dr. Beddoe, F.R.S., contribute a paper on the gradual diminution of the human head—a subject which has excited some little discussion in the press, but has been by no means thoroughly sifted. Mr. Tuckett's attention was first drawn to the subject by a remark made by a local hatter that during the last twenty-five years the size of hats had decreased by as much as half an inch in circumference. Messrs. Lincoln and Bennett, well known London hatters, state that the average size of hats sold by them has decreased from No. $7\frac{1}{25}$ in 1855 to No. $6\frac{19}{21}$ in 1880. Other evidence of a similar kind has been obtained from different hat manufacturers in England and Scotland, but it does not appear that enquiries have been made in Ireland, on the Continent, and in America. Nor does it appear whether the decline has only commenced within the last thirty years, or whether it can be traced to an earlier period.

Very little light has been thrown on the cause of the change. Dr. Beddoe suggests that there is "a certain degree of physical degeneration in the population of large towns." But decrease in the size of the head is not in all cases connected with diminution of stature, strength, or indeed intelligence. An instance has come under our notice where the size of the head has notably decreased in the male members of a family during three successive generations, though the stature has even more strikingly increased.

Mr. C. Richardson communicates an interesting geological paper on the age of the River Wye. Taking all the elements of the calculation at a minimum value, the smallest figure reached is 1,274,000 years.

Mr. H. S. Hele Shaw, C.E., discusses the methods of wind-measurement, a branch of meteorology of great importance, but as yet in a very imperfect state. As instances of the discrepant statements put forward by experts in the engineering phase of the question, thus Mr. Hawksley thinks that a pressure of 40 lbs. per square foot is unknown in this country. In America engineers hold that no bridge has been exposed to more than 30 lbs. per square foot. Yet the Committee on the Tay Bridge disaster state that at Bidstone, near Liverpool, a pressure of 90 lbs. per square foot was recorded, and on another occasion 77 lbs., and at the Oxford Observatory the pressure in the storm of October 14 was found as high as 53 lbs. The probability is that the pressure of the wind in tempests varies, not merely from moment to moment, but in point of space from square foot to square foot. So that supposing the pressure upon a square foot is registered at 40 lbs., it does not follow that a building exposing a surface of 40 feet by 30 feet would have to bear at any moment a pressure of 48,000 lbs.

Mr. S. H. Swayne gives a few remarks on the carnivorous "owl-parrot" of New Zealand, *Nestor notabilis.* The writer suggests that if this species continues to exist and maintain its carnivorous propensities, it may possibly develope into a decidedly raptorial bird. We fear that this interesting experiment is not likely to be tried.

Professor Ramsay communicates a most interesting memoir on the sense of smell. After contending that four of the senses —six in number if we include, as we fairly ought, the recognition of heat—are in all probability mediated by vibration, he asks whether smells are excited by liquids, solids, or gases? The two former states of matter being excluded experimentally, gases and vapours only remain. He considers that the property of smell is confined to some elements only. Substances which have no smell, or which are merely irritating when inhaled, have all low molecular weights. Among the carbon compounds, increase of molecular weight produces, to a certain point, smell. This the author exemplifies by several instances, such as the alcohols. Pure methylic alcohol he declares inodorous, "ethylic alcohol, when freed from ethers, has a faint smell, and the odour rapidly becomes more marked as we rise in the series until the limit of volatility is reached, and we arrive at solids with such of low vapour tension that they give off no appreciable amount of vapour at the ordinary temperature." Prussic acid, we learn, is not smelt by more than four persons out of every five.

A further conclusion is that smells are generic. Thus chlorine, bromine, and iodine, besides their specific differences in smell, have a something common to the whole group, which may be called a haloid smell. Very similarly sulphur, selenium, and tellurium, in combination with hydrogen have a generic odour. In like manner various generic groups of smells may be traced among the carbon compounds.

The tendency of a rise in the series is to make the smell "heavier," less etherial, and more characteristic.

As a theory of the sense of smell, which is hitherto a desideratum, Prof. Ramsay suggests tentatively the following. "There is a probability that our sense of smell is excited by vibrations of a lower period than those which give rise to the sensations of light and heat. These vibrations are conveyed by gaseous molecules to the surface net work of nerves in the nasal cavity. The difference of smells is caused by the rate and by the nature of such vibrations, just as differences in tone of musical sounds depend on the rate and on the nature of the vibration; the nature being influenced by the number and pitch of the harmonics." To produce the sensation of smell a substance must have at least fifteen times the molecular weight of hydrogen.

The author considers that we must look to radiant heat for indications of harmonics of the fundamental vibrations which are according to his theory the cause of smell. Prof. Tyndall has shown that odours have the power of absorbing heat rays. The author considers that smell is more analogous to sound than to light, since in a mixture of smells it is possible to recognise each ingredient.

This paper is in our opinion deserving of most careful study, and may, or rather should, lead to prolonged experimental research. The chief difficulty in the way is that this sense affords far more anomalies and idiosyncracies than the senses of sight and hearing. Numbers of persons declare that they can smell nothing where to others a very distinct odour is perceptible.

The same author read at one of the meetings a memoir on "The Connection between Chemical Constitution and Physiological Action." Unfortunately it has not found a place in the proceedings, and we can merely summarise the author's conclusions from the "Reports of Meetings." He finds that hydrocarbons have little, if any, action on the animal organism. 2. The introduction of oxygen, when the resulting substance does not produce local irritation, acts on the organism. A low molecular weight coincides with a transitory effect; and as it increases the effects become more marked. 3. Compounds containing chlorine all affect the organism. Its specific action consists in causing irregularity of the heart's pulsations and in lowering the blood pressure. The peculiar action of the carbon and hydrogen in compounds containing chlorine is to produce irritation in the nerve-centres and in bodies of high molecular weight to cause spasms. 4. Nitrogen shows great versatility in the part it plays. Many bodies containing it, such as the natural alkaloids, have their poisonous action greatly lessened by the addition of methyl and similar radicals, while others become much more active by their addition. 5. Increase of molecular weight corresponds with increased toxical action. 6. Polymeric bodies have a different, and in some cases a much more energetic, action than the compounds from which they are built up."

It is not stated in what manner the compounds in question have been introduced into the animal system—a point of some moment in comparing Prof. Ramsay's results with those of other experimentalists, nor do we learn what animal species were operated upon.

In addition the number before us contains a memoir by Prof. Sylvanus Thompson, on "Volta-electric Inversion;" one on "Our Knowledge of the Nature of Chemical Phenomena," by W. A. Shenstone; on "Brownian or Pedetic Motion," by Professor Ramsay; on "Colliery Explosions," by E. Withered; and on the "Smoke Abatement Exhibition," by Professor J. F. Main.

We think our readers will agree with us that the Bristol Naturalists' Society deserves well of all friends of Science, and is setting an excellent example to similar societies elsewhere.

CORRESPONDENCE.

⁂ The Editor does not hold himself responsible for statements of facts or opinions expressed in Correspondence, or in Articles bearing the signature of their respective authors.

BURROWING BEETLES.

To the Editor of the Journal of Science.

Sir,—Your able contributor Mr. G. H. Kinahan, in his interesting paper on the formation of vegetable soil, as inserted in your July issue, makes due and true notice of the services of certain beetles in deepening the soil. The blue species which he says are locally called by the singular name of " bumbly bees " are without doubt some kind of *Geotrupes*, and very serviceable they are in loosening the soil, carrying down and covering up the excreta of horses, cows, &c., and bringing up heaps of clay, &c. I should think that in pasture-lands they must be more efficient agents than earth-worms. The larvæ of the " cockchaffer " (*Melolontha maialis*) penetrate into the earth to the depth of 2 feet or more, but I have never known them bring up any appreciable quantity of soil. The female, when about to lay her eggs, generally selects soils already well loosened by cultivation, as she has not the robust legs of the *Geotrupes*.—I am, &c.,

An Essex Coleopterist.

THE ADVANCEMENT OF MEDICINE BY RESEARCH.

To the Editor of the Journal of Science.

Sir,—Is the " Association for the Advancement of Medicine by Research, which was inaugurated by such a number of illustrious scientific men, medical and non-medical, a *bona fide* working body, or was the meeting on March 28th a mere demonstration? [We are here compelled to cut out a political allusion in which our correspondent has indulged.] I do not see that it has done anything at all in proportion to the expectations entertained and the promises held out. Prof. Owen's excellent little work on Physiological Experimentation, which seems to be issued under its sanction, might have appeared equally well without it.—I am, &c.,

A Graduate.

NOTES.

H. A. Brons (" American Naturalist ") gives some most valuable notes on the habits of some of the serpents of the Western States. The garter snake (*Eutænia radix*) captures great numbers of fishes which have been left in shallow water when the floods have receded. In Texas and Mexico it is not uncommon to catch the venomous " cotton mouth " (*Ancistrodon piscivorus*) whilst fishing with hook and line. The prairie dog (*Cynomys ludovicianus*), the rattle snake (*Crotalus confluentus*), and the burrowing owl, though they dwell together, do not form a happy family. Both the snakes and the owls destroy the young dogs, and the snakes make free with the eggs of the owls. Several snakes, *Bascanium constrictor* and others, swallow the eggs of the domestic fowl unbroken. The blowing adder (*Heterodon simus*) seizes the hind foot of the box turtle (*Cistudo ornata*), and sucks the blood from it. The author caught a snake in the act. The foot of the turtle was bleached, and blood was still flowing; two toes were missing, and had been digested from the foot. The notion that snakes only attack creatures which they can swallow must be abandoned.

An eminent medical contemporary writes :—" Our profession ought to feel flattered by its exclusion from the honour (?) of baronetcy. A Mr. Lawes—an estimable gentleman who deals in manure—has just been decorated by Her Majesty. Probably the next " Gazette " will contain the names of the proprietors of Thorley's cattle food—hop bitters—and of the immortal 'Cockle.' Surely Col. Burnaby might be induced to do something with the Premier for his *protégé*." But the Mr. Lawes in question has fairly earned national honours by the Rothamsted experiments in agricultural chemistry, which but for him would never have been carried out.

We regret to announce the death of Prof. Emilio Cornalia, of Milan, an eminent entomologist, and author of the best-known work on the anatomy and physiology of *Bombyx Mori*.

Prof. J. Hutchinson, in a lecture delivered at the Royal College of Surgeons, maintains the persistency of a considerable Roman element in the population of England. (A day's walk in the " Back-bone of England," *e.g.*, to the west of Halifax, will reveal to the ethnologist abundant specimens of the typical Roman features and complexion. In view of such facts we may calmly ignore the assertions of modern historians.)

M. C. Richet ("Comptes Rendus") has made a series of experiments to determine the proportional "toxic power" of the alkaline chlorides. The animals operated upon were guinea-pigs, and the chlorides were introduced by subcutaneous injection. According to his results there is no relation between the atomic weight and the physiological activity. Lithium, which has the lowest atomic weight, is poisonous in the smallest dose. Rubidium and cæsium, whose atomic weights are highest, are more inoffensive than potassium and sodium.

Prof. E. de Cyon ("Ciel et Terre"), having studied the action of high atmospheric pressures upon animals, concludes that oxygen is not a special poison for the organism; animals die at such pressures because the carbonic acid (the chief excitant of the vaso-motor and respiratory centres) diminishes sensibly, and circulation and respiration are arrested.

On the West coast of Africa teetotallers die first, hard-drinking men second, whilst the temperate live longest.

Dr. G. Johnson has, in his recent "Harveian Oration," effectually disposed of the pretensions of Cesalpino to be regarded as the discoverer of the circulation of the blood—pretensions advanced chiefly by Italians and Anti-Vivisectionists. The latter at one time sought to show that Harvey had not been led or assisted in his great discovery by experiments upon living animals. When this ground became untenable they turned round, and denied that Harvey had made any discovery at all!

Dr. Niemeyer's "Athem-gymnastik," or breath-gymnastics, is calculated to meet a real evil. Brain-workers undoubtedly fall into the habit of imperfect breathing.

Mr. Wilkie Collins is coming forward as an enemy of Science. He is about to attack experimental physiology by tracing the effect of the habitual practice of "cruelty" on human character.

Mr. J. A. Gotch has lately read before the Architectural Association an exceedingly able paper on "Art in Dress." His views being thoroughly rational will be practically ignored by the British public.

For the benefit of those who still confound Evolutionism with Positivism, we quote the following dictum of M. Charles Robin, the positivist leader:—"Darwinism is a fiction, a poetical accumulation of probabilities without proofs, and of seductive explanations without demonstrations.

M. Moigno ("Les Mondes") writes:—"In Germany they only accept with great difficulty discoveries which come from abroad, especially, perhaps, those coming from France!" We have always found Germany more prompt to recognise foreign merit than France. Witness the case of Darwin.

M. G. Hayem (" Comptes Rendus ") traces the spontaneous cessation of the escape of blood from an injured vessel to the hæmatoblasts, which, on coming in contact with the edges of the wound, adhere to it, and gradually accumulate till they block up the aperture.

Prof. V. Graber (" Archiv. für Mikros. Anatomie) has made a series of experiments on the hearing of insects. He found a common cockroach, two beetles (species ?), a *Chrysopa*, and a house-fly very sensitive to sound, whilst the larva of the cockchafer and several species of ants gave no marks of recognising the strongest sounds and noises. Water-bugs of the genus *Corixa* were much excited by sound, whilst mechanical agitation of the water did not seem to disturb them.

L. O. Howard (" American Naturalist ") finds that *Metapodius femoratus*, a large field-bug, sucks the juices of the caterpillar of *Leucania unipuncta*, the " Northern army worm," and leaves the exhausted and shrivelled corpse suspended over a forked branch of May-weed (*Maruta cotula*). " The whole long line of May-weeds was garnished with the empty skins of *Leucania* larvæ, each carefully hung over the fork of a branch."

Mr. Chichester Ward (" Report on Botany of Polar Regions") notes that in the low grounds of Southern Greenland true blue flowers, such as *Veronica alpina*, are rarely met with, whilst true reds never occur.

W. Irvine Fortescue (" Scottish Naturalist "), in a paper on the flowering plants and ferns of the Orkneys, states that *Fuchsia magellanica* thrives in the open air in Orkney, and that *Phormium tenax* flourishes in North Ronaldshay.

The " American Naturalist " complains, with justice, of an additional tax on knowledge with which the student in the United States has to contend. Books coming through the foreign posts are charged with an import duty of 25 per cent if the value exceeds a dollar. A number of tedious formalities are also required, and there is of course the risk of the book disappearing altogether.

S. A. Forbes (" American Naturalist ") mentions that " if there were no Entomostraca for young fishes to eat, there would be very few fishes indeed to prey upon Mollusca, and that class would flourish almost without restraint. On the other hand, if there were no Mollusca for the support of adult fishes, Entomostraca would be relieved from a considerable part of the drain upon their numbers, and would multiply accordingly.

M. J. Rossbach (" Med. Central-Blatt.") has observed that whilst the blood of a healthy rabbit is free from moving organisms, immediately after the injection into a vein of 0·05 to 0·1 grm. of the vegetable ferment papayotine, the blood swarmed with true bacteria. This fact supports the opinion that in true infections, along with the inoculated organic germs, a simultaneously present chemical poison is not without importance. Rosenberger has observed a similar result on the injection of septic matter which had been previously freed from bacteria by boiling.

Lord Talbot de Malahide, in a paper read before the Anthropological Institute, treated on the longevity of the Ancient Romans in North Africa. The author gave several instances of epitaphs and inscriptions on tombs of persons whose age had exceeded 100 years ; in some cases an age of 120, 130, and even 140 years had been attained. These facts do not agree with certain current notions.

According to the experiments of Herr W. Detmer (" Landwithschaftliche Jahrbücher ") vegetable cells are not able to decompose nitrous oxide, but are injured by its presence. In hydrogen gas no growth is possible, and the plants are injured. In pure carbonic acid seeds do not germinate, and etiolated plants do not become green. Vapours of chloroform injure growth, but the process of respiration is not brought to a standstill.

We regret to learn that the proposed statue of Darwin is to be erected at South Kensington. Surely some more central locality could have been found.

M. l'Abbé Moigno (" Les Mondes ") notices, in a very laudatory manner, an Anti-Evolutionist treatise entitled " La Lutte pour l'Existence."

M. Bouquet de la Grye (" Annales de Chimie ") finds, in accordance with Gay-Lussac and Humboldt, that in the region of both tropics the ocean contains more saline matter than at the Equator and beyond the Tropics.

It is stated that the common house-fly is capable of emitting sounds perfectly distinct from the buzzing of its wings, and which may possibly serve these pests as a means of mutual communication.

The Committee appointed by the Royal Microscopical Society to consider the advisability of adopting standard guages for eye-pieces and sub-stages, has, after consulting the principal microscope makers in London, come to the conclusion that two sizes should be recommended for eye-pieces, viz., No. 1 for large instruments, 1·35 inches, and No. 2 for smaller instruments, 0·92 inch, in both cases external diameter. These are selected from sizes at present in use, the No. 1 guage being that usual with most of the larger instruments constructed in England, whilst No. 2 is that adopted for small stands by many continental makers. As sub-stages are frequently of the same diameter in small instruments as in large ones, one standard size is deemed sufficient, viz., 1·5 inches external diameter. The standard screw for objectives authorised many years ago by the Society has been almost universally adopted: it is to be hoped that for the future eye-pieces will only be made of the specified sizes; the inconvenience attending the parts of various instruments not being interchangeable is very great, and might in the course of a few years disappear if all new instruments were made to the standard sizes. With regard to sub-stage fittings, in most instances the 1·5 size has been found to be already in use.

M. J. Dembo ("Comptes Rendus") suggests the existence of a physiological relation between uterine excitability in various animal species and their fecundity.

M. Dastre, in a communication to the Academy of Sciences, shows that, if the normal rhythm of the heart is disturbed by inducing artificially a new contraction after each provoked systole, there follows a compensatory repose which re-establishes the rhythm.

The water of the Rio Grande holds in solution a trace of ruthenium.

Dr. Vogel ("Vienna Akad. der Wissenschaft") has demonstrated the presence of formic acid in the hairs of the larva of the processionary caterpillar.

Mr. H. Warner, of Rochester, New York, offers a prize of 200 dollars for any meteoric stone found in the United States and containing fossils revealing the presence of animals or of plants. A prize of 50 dollars is offered for a specimen of any areolite which has been seen falling in 1882.

According to an American journal, quoted by "Ciel et Terre" under the insufficient name of the "Chronicle," there is a relation between atmospheric humidity and the number of conflagrations, any cause affecting the one telling also upon the other.

M. Bouquet de la Grye (Academy of Sciences) contends that the temperature of the sea and its degree of saltness are factors to be taken into account in explaining the phenomena of the tides.

At the *Soirée* of the Society of Chemical Industry, held at Owens College, Mr. Fletcher, of Warrington, demonstrated the possibility of the combustion of gas without visible flame, the heat obtained from a ¼-inch gas-pipe being sufficient to fuse wrought-iron into drops.

We deeply regret to learn the untimely death of one of our most distinguished biological investigators, Prof. Balfour, of Cambridge.

Says a contemporary, " In France, Science is to some extent restricted by being confined within certain programmes, and a principle in order to be admitted has to be accepted by a clique of theorists, who generally show great reluctance to change old erroneous notions, and very often write in order to suppress what is not in accordance with their ideas." This is very true, but does it refer to France only?

According to Mr. H. Percival, if population goes on increasing at its present rate, in 214 years the world will have reached the frightful average of 700 inhabitants to the square mile.

Dr. J. F. Snyder (" Kansas Review of Science ") declares that no traces of a " Stone Age " have been discovered in Africa.

M. Th. Anger, whilst Demonstrator of Anatomy at Clamart, witnessed the death of a female sloth and her six young ones, from tetanus. They had lived in a stable in which two horses had died of the same disease.

M. F. Carré (" Comptes Rendus ") shows that the cost of refrigerating hams, &c., to the point necessary for the destruction of *Trichinæ* and other parasites, is rather less than 0·01 franc, or about one-tenth of a penny, per kilo.

Dr. G. Dickie, ex-Professor of Botany at the University of Aberdeen, died quite recently. He had occupied his chair honourably for seventeen years, but had been compelled to resign in 1877 in consequence of failing health.

J. P. Finley, of the U.S.A. Signal Service, contributes to the " Kansas Review of Science " a most valuable paper on tornadoes, in which he draws distinctions between cyclones, tornadoes, hurricanes, and whirlwinds.

The Albert Medal of the Society of Arts for this year has been assigned to M. Pasteur,—certainly not the least meritorious of those to whom this honour has been awarded.

The "Herald of Progress" speaks thus of scientific specialists:—" We have, mingling with men in scientific circles, divisional know-nothings beyond the structure of the petal of a flower, or of a beetle, or other trumpery auxiliary in the army of animated forces; who strut and act big in the high-heeled boot of a fellowship. Such five-feet-one-inch giants tell us prophecy is a myth, only practised by almanack makers and their compeers, because to such anti-rationalists and oblivionists hereafter is a myth—the one is impossible, because the other is."

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I. WITCHCRAFT, INSANITY, AND CRIME.*

By Frank Fernseed.

It is undeniable that the last word concerning witchcraft has not yet been said, and is scarcely at present even to be expected. After having filled for centuries an important part in the beliefs of our ancestors, and having left its dark-red stain on the records of their social life, of their legislation, and of their jurisprudence, it was consigned to the limbo of forgetfulness as an exploded delusion, an odd mixture of madness and imposture not worth the serious notice of any enlightened man. In this estimate it was forgotten that even the wildest misbeliefs are psychological facts deserving careful study, and, further, that the possibility and the actual occurrence of witchcraft have never been formally disproved. To do so, in fact, would require a demonstration either that no spiritual beings exist, or that, if existent, they have no power to interfere in human affairs. We may perhaps believe these propositions, but how are we to establish them to the satisfaction of the candid doubter?

Furthermore, there has been a "turn of the tide," in virtue of which not a few thinkers, men of learning and reputation, admit that incorporeal and ordinarily invisible beings, whether parastatic spirits or the ghosts of defunct men (and beasts ?), may affect the living either for good or evil. These views, indeed, are by no means accepted by Dr. Beard. He speaks of Spiritualism, Animal Magnetism, and Mind Reading as delusions which have been welcomed in Europe after having been "exposed and shorn of their force in America." Or again, speaking of the accusers of the alleged Salem witches, he says—"Out of such a circle as this developed the spirit-rapping excitement at Rochester, which was the modern evolution of witchcraft known as Spiritualism : in such circles the Eddy Brothers, in my presence, recently raised the dead, and Katie King appeared in human form. If this Salem circle of afflicted children had possessed the rapping power with joints that the Fox girls possessed ; if they could have read muscle like 'Brown the mind-reader' and his disciples ; if they could have achieved any of the slate-writing tricks of modern mediums, their power for evil would have been titanic." But this very reaction against the possibly too-sweeping scepticism of the first half of the present century, which Dr. Beard here denounces, is a reason for a thoroughly scientific study of the subject. Until such study has been completed witchcraft must continue to have more than a mere historical significance. This being, however, admitted, I must presume to differ from Dr. Beard on some points not without importance. He attaches to the New England witch-mania of 1692, and its deplorable cruelties and murders, an importance which they can scarcely claim. He tells us that "the twenty victims of the Salem judicial massacres were nearly the last of the immense army of murdered witches"; that "England in 1692 would not have executed twenty of her citizens for witchcraft"; that "it was the last act in the long tragedy of terror and blood"; and that the "erroneous belief" in sorcery "starving for want of pasture in Europe" experienced in New England a transient recovery. Dr. Beard here pays Europe too high a compliment. If the testimony of Dr. Parr is to be believed,* two witches were executed at Northampton in 1705, and in 1712—twenty years after the Salem tragedy—five more suffered capitally at the same puritanical town. In Scotland a victim was put to death in 1722. The sub-prioress of a nunnery† suffered execution by fire at Würzburg in 1749 ; and one Anna Göldi perished at the stake at Glarus, in Switzerland, as recently as 1781—the horrors of mediæval ignorance thus almost blending with those of revolutionary enlightenment !

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* The Psychology of the Salem Witchcraft Excitement of 1692, and its Practical Application to our Own Time. By G. M. Beard, A.M., M.D. New York: G. P. Putnam's Sons. London: Trübner and Co.

The Case of Guiteau: a Psychological Study. By G. M. Beard, A.M., M.D. New York.

The Problems of Insanity. By G. M. Beard, A.M., M.D.

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* Buckle, History of Civilisation, i., p. 333.

† Horst, Zauberbibliothek.

It is therefore not easy to recognise the Salem murders as "the last struggles, the death-rattle of the monster that had been wandering for centuries wild over Europe." They were merely one scene in its decline.

In order "to answer the question why the last bloody battles of witchcraft were fought on American soil," Dr. Beard considers it necessary to "know something of the intellectual character of the American people, and of the race to which they belong." His remarks on this subject are so interesting and suggestive that I quote them, even after having shown that the last dying struggle of witchcraft took place elsewhere :—

"The Anglo-Saxon peoples in both Europe and America have, in modern days, a genius for non-expertness in Science. That we might preserve our political freedom we have in other directions become as slaves bound in time-rusted chains of common delusions ; we have sacrificed almost everything else that we might have liberty." Parenthetically I remark that this "political freedom" may prove to have been dear at the price. "Were we not," he resumes, "constantly nursed at the breast of Germany, both England and America would long since have starved to death scientifically." I fully admit here that in the number of sound scientific workers, and consequently in the quantity of research produced, we are far inferior to Germany. But Faraday and Darwin may serve as sufficient instances to show that our deficiency lies not in any in-bred peculiarity of race, but in artificial circumstances, which at present drive or tempt all our best minds away in other directions, and which it is, to a great extent, within the power of the Government to alter. I refer, *e.g.*, to the possibility of appropriating University fellowships as the reward of successful research.

Dr. Beard continues :—"This genius for scientific non-expertness is attended by a genius of almost equal power for intellectual timidity. Of all great peoples the English-speaking peoples are the most cowardly in the face of ideas : of such were our ancestors in England and New England ; of such, in fading degree, are we at this hour. The one prayer of the puritan mother, that her child should never learn to think, has been answered, and thus far America has given no philosophy to the world." Has Spain, or has Russia ? To continue my quotation :—"With all our opportunity, with all our advance, no other enlightened nation has expended so much cerebral force in the emotion of fear as has America. Always our fathers were kept on the run before new truths ; they would be above the suspicion of

Science. Instinctively, as chickens run with cries from the shadow of a hawk flying high in the air, these puritans ran at the approach of new truths, hiding themselves in trembling terror under the broad wings of the church."

Here, then, we have a new count, not to be omitted when the indictment of puritanism is being drawn up. That she has been a poison to the æsthetic life of the nation, deadly to high art and to poetry, is to some extent admitted. That she has been no less baneful to Science and Philosophy is a grave aggravation of her guilt. But yet again, I must ask is the "approach of new truths" viewed with terror only, or even mainly, in England and America? I have heard of and met with Alethophobia, a feeling far from rare wherever there exist cliques of official *savans* who "show great reluctance to change old erroneous notions, and very often write in order to suppress what is not in accordance with their ideas."

Dr. Beard views witchcraft as an essentially morbid, pathological phenomenon, devoid of any subjective basis. Hysterical persons in an ignorant age believe their sufferings, real or imaginary, to have a personal external cause—the ill-will of spiritual beings, or of human neighbours supposed to be in league with spirits. Such persons are the "afflicted," the accusers and witnesses. They are generally young females mutually well acquainted, and given to fostering the delusions of each other. The accused, the so-called witches, are not unfrequently also hysterical, or even insane, and appear in some cases to have believed themselves in league with spirits and in possession of supernatural powers. There are, however, some curious circumstances connected with the selection—as it may be called—of victims, and these circumstances point to an element of imposture, deception, and even malignity. Why, else, were accusations of sorcery brought, both in Europe and America, pre-eminently against the unpopular, the poor, the uninfluential? In Catholic countries the imputation of witchcraft was closely connected with the charge of heresy. In New England the first victims accused were persons of mean estate, unprotected, and who had probably drawn unpleasant attention upon themselves by some harmless eccentricity of conduct, or even by some peculiarity of appearance. But at Salem, as elsewhere, the accusers were emboldened by success, and struck higher. This presumption in many places put a check to the judicial murders. When nobles, judges, clergymen, military and naval officers of rank, or their wives and daughters were denounced as sorcerers the authorities were startled, and the public in general began to ask the question, "Who is safe?" In short, the witch-massacres came to an end much on the same principle as did the "reign of terror" in the first French Revolution.

A prominent feature in Dr. Beard's treatment of the question of sorcery is the parallel which he attempts to draw between the Salem witch-trials and the recent condemnation of Guiteau. Both, he considers, turned upon insanity. He admits one important distinction,—*i.e.*, that in the Salem inquisitions the insanity was on the part of the accusers and witnesses, whilst in the recent transaction at Washington it was on the part of the accused. He fails, however, to note a distinction which to me seems all-important. No one doubts, or could doubt, that President Garfield was murdered,—or killed, if the term murder is objected to. Nor could any one deny that Guiteau, taken as he was "red-handed," was the man who fired the fatal shot. But in the witch-trials the case was totally different. Suppose Ann Putnam, one of the "afflicted," really felt unpleasant symptoms, which were described as choking, pinching, biting, and generally tormenting, there was no proof that these phenomena had any outward objective cause at all! Still less was there any proof that the person accused had any more connection with these alleged sufferings than any other of the thousand million inhabitants of the globe. There was indeed testimony,—*i.e.*, assertion,—but it was utterly unsupported by facts. Great weight was laid upon the so-called "spectre evidence." If one of the accusers swore that she had seen the spectre of the accused in the form of a bird or beast, this was deemed, or dreamed, proof that the defendant was a sorcerer! Hence the parallelism between, say, Mrs. Nurse and Guiteau is not of the closest or most accurate. The latter suffered for a deed actually committed, and committed by him only; the former was done to death for an imaginary deed, with which she had no demonstrable connection.

Dr. Beard's views on the position of the insane before the law are peculiar, perhaps in some extent dangerous. He holds that "no more than children, no more than animals, can they be legally punished." Surely anything which is a peril to society not only may, but should be, eliminated—the idea of punishment being totally irrelevant. The assassin is like an infectious cesspool. We do not punish the latter, but we incapacitate it by disinfection from doing further harm. Just so with the murderer; public security demands his elimination, and whether that elimination take the form of the gallows or of perpetual imprisonment is a secondary question. The essential points are that he shall not have the opportunity of repeating his offence, and that, in view of the heredity both of insanity and crime, he shall on no account be suffered to become a father.

As regards animals they are not, indeed, in these days arraigned before courts of law, but they are frequently punished for their offences, and the dread of punishment weighs with the more intelligent domestic species—horses, dogs, even cats—as a powerful motive in deterring them from actions to which they are otherwise inclined. Even elimination is, pending that "emancipation" of animals of which some hysterical spirits dream, the recognised doom of individual brutes which have committed some grievous outrage, and indeed of entire species which have been found perilous to man's person or his property. The tiger and the wolf cannot help, in virtue of their very nature, preying either upon our flocks and herds or upon ourselves; but this plea renders their extirpation all the more imperative.

The following doctrine seems to me fraught with grave dangers:—"It will be held that a lunatic may be capable of making wills and contracts, and of giving testimony in court, even if not responsible for any offence he may have committed."

It is important to note that Dr. Beard fully admits that the plea of insanity has been abused to the acquittal of the guilty, who have thus not merely escaped the scaffold, but have been turned loose upon the world again. He writes:—"The psychology of the future will not admit the plea of insanity except for those who are seriously sick in mind, and who manifest their insanity by decline in the instinct of self-preservation (it is declining in the people of England, *pari passu*, with the tribal instinct), and in the power of adapting themselves to environment, by important moral decline or by lack of rememberable consciousness; simple eccentricity, or hypochondria or hysteria, or morbid impulses or morbid fears, will not be regarded as diagnostics of insanity." It must be admitted that Psychology will have to make great progress before experts cease to differ on such delicate distinctions.

Returning to the main subject, it will astonish not a few to learn that "at this very hour, in and around Salem and adjoining Massachussetts towns, witchcraft is cherished by the sons and daughters of these Puritans: they may not know or confess that they are believers in the delusion, and the fact of such belief would only be brought out by close cross-examination, which I have sometimes made; but in this doctrine, the root, the basis, the life, the soul of witchcraft, —that the devil enters into and takes possession of men, and binds them over to himself,—they have made no advance, or but little advance, over their Puritan ancestors of 1692."

There is much of deep import in the following remarks on the commingling of delusion and imposture:—"In psychology, if not in theology, the doctrine of the trinity is verifiable; in a single person we shall find the deceiver, the partially deceived, and the wholly deceived; three in one and one in three; unity in diversity and diversity in unity; an engrafted tree bearing varied fruits all nourished from a common trunk, and rooted in the soil of superstition. We are often deceived when we suppose we are deceivers—dupes even more than charlatans." However widely the reader may differ from some of Dr. Beard's fundamental views, he cannot fail to recognise the fearful truths conveyed in this passage.

Not less significant is the author's comment on the part played by witchcraft in the education of our race:—"Delusions are not only inevitable, but they are indispensable to mankind. Our planet is ruled, is destined to be ruled, by the imagination. The world can do without science—the demonstrably true; few indeed have any science, and those few but little; the world can even exist for a time without religion, or with almost none; the demonstrably false it will not and cannot do without. Witchcraft, bloody and terrible as it is, has probably been of supreme service to civilisation, if indeed it be not a part of the very foundation of all our culture. Our not very far distant ancestors were coarse and brutal savages who must be frightened into the pathway of civilisation; and for such the belief not only in a personal and ever-present God, but in a personal and ever-present, or liable to be present, Devil was requisite. Says Varro—'It is necessary that the people should be ignorant of many things that are true, and believe many things that are false.'"

At least, whether necessary or not, it is the case not less now than heretofore.

II. BESTIARIANISM *v.* COMMON SENSE.*

(Concluded from page 460.)

IN our last issue we showed the utter and fatal inconsistency of those persons who condemn physiological experimentation, and who yet make themselves, personally or by proxy, parties to the infliction of restraint, pain, and death upon animals on an incomparably—we might almost say infinitely—larger scale. We turn now to those who at least strive to be consistent, and whose object is the emancipation of animals alike from the scientific experimentalist, from the sportsman, the angler, the butcher, the castrator, the horse-breaker, and driver. Whether any living person really takes this point of view in its entirety, after a full consideration of what it involves, may be doubted. We have heard of persons who mount the anti-vivisectionist platform, who eschew animal matter for food and clothing, and who reject "sport" in all its branches. But they still employ the forced labour of animals; they would cultivate the ground, although in so doing they must destroy—as Mr. Mattieu Williams reminded them in a recent issue of the "Journal of Science" (p. 396)—myriads of animals, and if troubled either with *Epizoa* or *Entozoa* they would not scruple to apply, in the one case, Persian powder and the small-tooth comb, and in the other anthelmintics. Consequently such persons must either admit of arbitrary exceptions to their creed of animal emancipation, or they must make themselves a party to their own extirpation and that of their species. If we cease feeding upon oxen, sheep, hares, rabbits, &c., we must make an end of them; for when no longer to be made subservient to our purposes they become simply enemies, who, if they do not attack us personally, wage war against us by occupying and spoiling the ground, and by consuming the fruits of the earth. Even now the competition between man and man renders it difficult enough for men to live. What will be the case in

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* Experimental Physiology, its Benefits to Mankind. By RICHARD OWEN, C.B., M.D., F.R.S., &c. London: Longmans.

The Uselessness of Vivisection upon Animals as a Method of Scientific Research. By LAWSON TAIT, F.R.C.S. Birmingham: Herald Press.

The Ethics of Vivisection. By Dr. S. WILKS. Contemporary Review.

214 years, when, as statisticians tell us, the human population of our globe will amount to an average of 700 persons per square mile of its whole surface? Can we afford to give up millions of acres to be the haunt of wild horses, cattle, and swine, and to be drilled and undermined by rabbits? Unless self-preservation ceases to be either the first or the last law of our nature we must reply to the advocates of animal emancipation with a stern *non possumus*. We must refuse to commit racial suicide. There is a legend of an Indian saint who gave his own body to preserve the life of a famishing tigress, and we have seen the deed extolled as an instance of self-denial. In reality it was a grievous crime. If the tigress preserved by his sacrifice slew afterwards any other human being he was constructively, but not the less decidedly, a murderer.

Surely, then, summing up the foregoing considerations, it may be said that the Bestiarian position is every way untenable. Unless they refrain entirely from giving pain to animals they are inconsistent; if they do so refrain they cannot exist.

Having thus cleared the ground we may come to an examination of Mr. Lawson Tait's pamphlet. His opening remarks on the needlessness of vivisection for purposes of demonstration we may at once dismiss as foreign to his and our purpose. We then come to the following strange passage:—"The position of vivisection as a method of scientific research stands alone amongst the infinite variety of roads for the discovery of Nature's secrets as being open to strong *prima facie* objections." We reply that there are but two such roads, observation and experiment; if the latter is closed to the investigator in animal physiology he will indeed, among all students of Science, stand alone. If we ask what is the strong *prima facie* objection, we find it consists in "a strong and widespread public sentiment"—more accurately described as an artificially created public prejudice or delusion—and the alleged uncertainty of the results. Says Mr. Lawson Tait:—"No one can urge the slightest ground of objection against the astronomer, the chemist, the electrician, or the geologist, in their ways of working; and the great commendation of all other workers is the comparative certainty of their results." But a short time ago no one objected to the physiologist, and no one certainly now can venture to guarantee that a popular outcry may not suddenly be raised against research in other departments of Science. Whispers are already heard that the fanatical party will by no means desist from their agitation. Not to go into details, it is actually hinted that experiments on hybridisation among plants will shortly be denounced on the score of "indecency"!

The results of the experimental physiologist are often, we are told, uncertain. It may naturally be expected that the more complicated the subject the more difficult must experimentation become. But is that any reason why we should desist from experiment when we have no substitute? Mr. Tait must be aware that in other sciences, also, self-contradictory—and therefore to some extent erroneous—results have often been arrived at, not merely by tyros and bunglers, but by men of established reputation. The truth, let us remind him, is not always readily and easily reached in physical and chemical experimentation. But the fact of this difficulty has always been felt by physicists and chemists to be the most urgent reason, not for the abandonment of experiment, but for its multiplication and repetition under varied circumstances. By acting on this principle the truth is ultimately reached.

We now come to Mr. Tait's "four avenues of thought," which seem to be four ways leading certain people to deny—or at least to doubt—the permissibility of physiological experimentation. The first of these is "the avenue of pure abstract morality, by which it is argued that we have no right to inflict sufferings on others that we ourselves may benefit." This "avenue," we reply, proves, if anything, far more than the public would care to hear. If we may not inflict sufferings upon others for our benefit, what right have we to kill animals for food, to force them to drag our carts and coaches, to emasculate them, or to destroy, rats, mice, bugs, cockchaffers, wireworms, slugs, and multitudes of other animals, large and small? Mr. Lawson Tait's first avenue, therefore, only leads into the quagmire of inconsistency in which the majority of "anti-vivisectionists" contentedly wallow. But we have yet to note a curious addition. Mr. Tait writes—"An avenue which is worthy of the highest respect, because its opening up is only a matter of yesterday, in the evolution of the moral life of individuals, and, as far as national morality is concerned, it can hardly be said to have been ever seriously considered until about a year ago."

We have always been of opinion that truth, whether new or old, was equally valuable. But we must utterly scout the contention that a doctrine deserves the more respect from its novelty. A man was sane until about a year ago: recently he has become deranged. Are we to hold his present notions of value simply because they are only a "matter of yesterday"? Yet to this conclusion Mr. Tait's line of argument must lead us. We fear he forgets that Evolution is not always a movement upwards, so that the recent is not to be pronounced *ipso facto* superior to the old.

We next come to a consideration so far-fetched, so altogether questionable in its essence, that we are compelled to quote it word for word, lest we should be suspected of misrepresentation:—

"The second may be called a political avenue, and is also one of importance, though that importance is not visible at first sight, and may even be altogether denied by some of a particular shade of political conviction. But to those of us who regard the Game Laws as a prolific method of manufacturing criminals, of wasting public money, of preventing the development of agricultural industry, and hindering the development of the peasant from his present serfdom to his possible and perfect citizenship, this avenue assumes a mighty importance when we discover that the lay support of vivisection is derived mainly from those who maintain costly pheasant preserves in order to become amateur poultry butchers, and who maim pigeons at Hurlingham under the idea that it is amusement. Anyone, therefore, who objects to the Game Laws from political conviction will put vivisection upon its trial, and he must hear a good case before he consents to an acquittal!"

This argument, if so it may be called, when stripped of its unnecessary and totally irrelevant verbiage, amounts to the contention that whatsoever a game-preserver or a member of a gun-club supports is, if not absolutely wrong, at least so suspicious that it must be compelled to prove its own innocence before it can secure its existence. Or if Mr. Tait's assertion be generalised it amounts to this, that whatever a political opponent supports must be regarded with hostility!" The morality and the logic of such a contention stand on the same level, and need no exposure. This "important" second avenue is, in short, an appeal to the "*odium politicum*," a weapon no less reprehensible than the now unfashionable *odium theologicum*. It may be, from one point of view, a clever strategical move to place "anti-vivisectionism" in alliance with a political party, and to propitiate the *genius loci*. But it is a step ill-becoming anyone whose aim, we would fain hope, is truth. We should like to know what is the evidence to prove that the lay support of physiological experimentation is derived mainly from game-preservers and Hurlingham heroes?* We have been under the impression that the sporting world had mainly, if not exclusively, enlisted under the Anti-Vivisectionist standard. The "Society" and the sporting-press are, to the best of our knowledge, against us. We have never seen a defence of physiological experimentation by any known, typical, game-preserver. We could give the names of fox-hunters, owners of buckhounds, battue-sportsmen, and anglers, whose sympathies are avowedly given to the Anti-Vivisection movement. Thus Mr. Froude, the eminent historian, a pronounced Anti-Vivisectionist, is not merely an enthusiastic angler, but a defender of sport in general, as may be seen in his article on "Cheneys and the House of Russell."

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* It must be noted that England is at once the focus of "sport" and of "anti-vivisectionism."

We deny, in short, that the lay support of "vivisection" is derived mainly from the sporting world, and even if this were accidentally the case we hold that it would prove nothing. The Game Laws, be their tendencies evil or good, —a question which it does not lie within our competence to discuss,—have nothing to do with the matter at issue.

Before leaving this unhappy "second avenue" we ask whether the Birmingham Philosophical Society has not, like most such bodies, a rule prohibiting the introduction of party politics? If so, how came such a breach of order to be tolerated?

Turn we to the third "avenue"—"the religious one." Here we read that "the doctrine of Evolution has affected religion, as it has everything else. Admitting that the so-called lower animals are part of ourselves, in being of one scheme and differing from us only in degree, no matter how they be considered, is to admit they have equal rights. These rights are in no case to be hastily and unfairly set aside, but should be all the more tenderly dealt with in that civilisation and inventions are every day making it more and more difficult for the animals to assert their independence, or as it were to vote upon the question!" To this strange perversion of Evolutionism we reply,—1st, by pronouncing Mr. Tait's assumption of "equal rights" to be no legitimate inference from the fundamental truths of the New Natural History; 2nd, that if animals have equal rights with man, so also have plants; and 3rd, that if it be wrong to experiment upon our "poor relations," not less is it wrong to eat them, to enslave, and emasculate them. As Dr. Wilks well points out, it is a standing error of Bestiarians to speak as if there existed "among the public some principle of conduct towards the lower animals which has no place among experimenters." And again, "If a horse could define his rights would he admit the necessity of his going round in a mill the livelong day, or dragging a tram-car, with the never-ceasing jangle of bells in his ears?" If we look into Nature we find that every species has the right to maintain itself, and increase if it can, and in order to do so it must drive out, extirpate, or subjugate its competitors.

We come now to the last question, the value of physiological experimentation as a "method of scientific research." This is, in reality, the point which Mr. Lawson Tait, in the title of his pamphlet, undertakes to discuss. Greatly to our surprise he has not, in the strict sense of the words, even made the attempt. He does not refer to the many unsolved questions in physiology, and show either that they cannot be solved by experiment or that they can be preferably—or at least equally—well answered by some other method of research. He does not refer to pure biological investigation at all. On the contrary, he takes the following series of instances:—

I. Treatment of injuries of the head, and the theory of Contre-coup.
II. Amputation of the hip-joint.
III. Paracentesis thoracis.
IV. Subcutaneous tenotomy.
V. Treatment of aneurism, ligature, and torsion of arteries.
VI. Transfusion.
VII. Abdominal surgery.
VIII. Function of periosteum.
IX. The ecraseur.
X. The detection of poison.

In all these cases he attempts to show that the discovery had been made by someone else, or that it was practically useless, or that it was made without vivisection, or at least that vivisection played therein merely a subordinate part. Now admitting for argument's sake, as we can very well afford to do, that Mr. Lawson Tait is right in his contention, what has he proved? As regards the utility or uselessness of vivisection in scientific research, nothing! Not one of the instances which he discusses belongs to the region of pure biological inquiry, but, save the last, to practical surgery. In other words they are, or are supposed to be, inventions in practical art, not discoveries in speculative science.

We will make brief mention of some of the purely scientific questions which remain unsolved, and we will ask any candid "anti-vivisector" how they can be solved without direct experiment? premising that if any other method can be devised we shall be not merely satisfied, but grateful:—

1. Connection, if any, between the physical and chemical properties of bodies and their physiological action. Is atomic weight related, directly or inversely, with toxic power? Do bodies chemically homologous produce effects of the same class when introduced into the animal system?
2. Discovery, in the lower animals, of the functions of certain organs—*e.g.*, the palpi of insects, arachnids, and crustaceans; the specific difference in function of simple and compound eyes, where both co-exist. Conversely, the localising of the different senses, and the detection, possibly, of new ones.
3. Determination of the causes which may determine, or at least influence, animal variability. Here belong experiments on the results of exposing animals for successive generations to abnormal thermic, luminous, or hygroscopic conditions; to higher or lower degrees of atmospheric pressure; to atmospheres of different chemical composition, or, in case of aquatic species, to water more or less charged with saline matter; to a modified diet, &c., &c.

We mention these instances not as an exhaustive catalogue, but simply as specimens. We are aware that while under all these heads good work has been done, yet very much remains undone, and we must plead our inability to see how a final decision can be reached without experiment. The vast majority of the experiments required would indeed be in all probability painless, involving no bodily lesion at all. Yet, so far as vertebrate animals go, they would be, in the present state of the law, unsafe. They might occasion "inconvenience," and, given a wealthy and ignorant prosecutor, an unscrupulous and ignorant counsel, and a fanatical and ignorant judge and jury,—commodities all easily to be met with,—the inconvenience might be construed as pain. Should the clamour of the enemies of Science prevail, we presume the same danger will be extended to inquiries on insects, mollusks, and still lower forms of life.

It may, or rather it will be, said that such experiments have no immediate utility, and merely serve to gratify our "curiosity," as the love of knowledge for its own sake is courteously called. Surely, we reply, it is at last time that we should rise superior to the stupid Philistinism of judging truth by its immediate applicability and market-value. Of all the mistakes of our nation none is likely to cost us so dear.

Prof. Owen and Dr. Wilks have, each in his own department, done good service in combatting the Bestiarian mania. Mr. Lawson Tait has, in our opinion, completely failed in making out his case. We profoundly regret the tendency which he shows to import into the "vivisection" question the spirit of party politics.

III. JOTTINGS ON ODOURS, AND THEIR RECOGNITION.

By J. W. Slater.

THERE are some points connected both with the appreciation and production of odours of animals which seem to require further consideration. It is generally agreed that all species, possessing the sense of smell at all, like and are attracted by the odour of their usual food, or of substances of an analogous nature. We have also evidence that animals are agreeably impressed by the specific odour of their own species, or, in the case of widely-modified forms, of their own race or strain, and especially of individuals of the opposite sex. On the other hand, they are disgusted and repelled by the emanations of hostile species. These are the results which we might expect on evolutionist principles, and which we actually observe, whether we ascribe them to Prof. Jäger's soul-particles or not. At the same time we observe a few facts which we cannot well account for on the above-mentioned principles. I take as an instance the feline family. The natural food of all such creatures is, indeed, the flesh and blood of recently-killed animals; but in case of need they devour not merely carrion, but even excrementitious matter, and sometimes dig up the remains of the dead in cemeteries. We should naturally think that creatures capable of consuming such food must have preferences for odours not merely unlike, but totally opposite to those which we approve ; yet the fact remains that not merely the domestic cat, but the African leopard, and indeed all Felidæ whose manners have been closely observed, are passionately fond of many odours which man selects and enjoys. Lavender, thyme, marjoram, pennyroyal,—in short, almost all plants rich in essential oils,—have a well-known fascination for the cat. The leopard and the panther (if the latter is to be regarded as a distinct species) have been charmed into docility and submission by means of lavender-water. It is difficult to understand on what principle purely carnivorous species can be attracted by scents so totally unlike that of their food ; I may add, so totally unlike that of the animals themselves. A feline animal must, as a matter of course, find nothing offensive in the smell of its own species, and it is hard to conceive how, *e.g.*, a leopard can tolerate the smell of its own species, and at the same time can have a craving for lavender-water. The difficulty becomes the greater if we consider that—at least as far as is known—nothing similar has been observed among the other groups of carnivorous animals, though one of them at least (the Canidæ) has a far more acute sense of smell than the Felidæ. With some hesitation I venture to suggest that the plants in question may act upon cats as an aphrodisiac. When these animals find, *e.g.*, a bed of thyme, chamomile, &c., they roll upon it, and indulge in demonstrations exactly like those which they manifest when under the evident influence of sexual excitement.

Prof. Jäger is of opinion that animals, man inclusive, are moved to fear or anger, as the case may be, by the odour of a hostile species. He maintains, with much probability, that the specific effluvium of a cat is offensive to mice, and causes them to avoid her presence and neighbourhood : that of the tiger, he considers, is in like manner exceptionally offensive to mankind. Now the odour of the tiger, the lion, and other of the larger Carnivora, is without doubt highly unpleasant ; but I think a visit to the Zoological Gardens will convince anyone that many smaller animals, not personally dangerous to man, give off a still more disgusting and noisome effluvium.

In many cases an unknown or unaccustomed odour has a no less repellent effect upon animals than has that of a recognised enemy. Few beasts are at once more efficiently armed and more obstinately courageous than the grizzly bear, yet if he happens to approach a man from the leeward side, and detects his specific odour, without recognising its source, he withdraws in another direction. Many other and much less formidable animals can only be approached from the lee side. Even in regions so solitary that the wild animals can have no acquaintance with man's peculiar effluvium, further than as a something unusual and inexplicable, they still take the alarm. Hence the hunter generally finds it necessary to proceed against the wind when in quest of his game.

This simple principle, the uneasiness caused by an unfamiliar odour, may serve to explain some facts which are very commonly put forward as manifestations of a mysterious "instinct." Thus in laying traps, poison, &c., for wild beasts and vermin, from the tiger and the wolverine down to the rat, the objects in question retain a smell of the human person. The intended victim, on approaching, recognises at once that he is in the presence of a something unknown, and he avoids the bait accordingly, or tries how he may obtain it without putting himself in peril.

Another very similar case is found in the felicity, if I may use the expression, shown by herbivorous animals in avoiding poisonous plants. Take an ox, a sheep, or a goat to a country where the flora is strange; he will browse upon plants analogous in odour with those which have formed his diet in his native country. But whenever he perceives a strange effluvium given off he avoids the plant as doubtful. The same mistrust of an unusual odour has been magnified in the following case into a mysterious instinct:—The authorities of the Jardin des Plantes, finding themselves overstocked with bears, resolved to get rid of one by poison, and for this purpose gave the destined victim a bun upon which some prussic acid had been poured. The bear, noticing the unusual smell, immediately pushed the bun into the water, and let it wash till the obnoxious odour had disappeared. There is not the least reason to suppose that Bruin had an instinctive knowledge of the effects of prussic acid, if swallowed.

All this will seem to us much more likely if we reflect that nearly all mammalian species far surpass us in the sensitiveness of their scent-organs. Besides this, they do not blunt these organs by the use of irritating condiments and so-called "strong" drinks. What a difference may thus be produced, in the sensitiveness both of smell and taste, I had once an opportunity of noticing in the case of a lady, who, having been for some years a sufferer from neuralgia, was advised to renounce all hot liquids and all pungent condiments, such as mustard, pepper, &c. After long perseverance in this regimen she acquired a delicacy both of smell and taste which was astonishing to her friends. Her verdict as to the wholesomeness and purity of a water-supply was often of more than analytical accuracy.

But the lower mammalian animals have, as compared with man, a further advantage in the use of the sense of smell. Most of them can with ease bring the nose in contact with the ground, or with other low objects, which we can smell at only by dint of the tedious process of stooping, or by lifting the object up to our face. Hence, in virtue of the triple advantage above mentioned, they can at once decide if an enemy or a desired prey have recently crossed their path, and left its specific emanations on the ground or in the air. They live, in fact, in a world of odours, just as we live in a world of sights; and just as our eyes are always conveying to us information, so are they constantly receiving impressions through their noses. An unwonted smell, too slight even to attract our notice, is to them as significant as an inexplicable noise or a strange sight is to us. What wonder, therefore, if they are disturbed thereby, and at once put upon their guard?

A few remarks may be needful on the odours given off by animals. In some cases—as that of the skunk and the common water-snake—they are offensive and defensive weapons, consciously used under circumstances of danger. There are other cases where the specific odour may aid gregarious animals in finding their way back to their companions, or in recognising their mates of the other sex. But it is at least questionable whether, in some instances, the odour of an animal, whilst not powerful enough to repel enemies, may not serve to inform them of its presence, and put them upon its track. I have never been able to see what benefit the fox derives from his very strong odour. Let us suppose that a strain of foxes were to be developed in this country whose scent should be only one-fourth part as intense as that of the ordinary Reinecke: would not such strain, in virtue of the greater difficulty of following its scent, elude the hounds in a far greater number of cases, and in consequence be likely to gain ground upon, and ultimately to supplant, the ordinary loud-smelling breed? It may of course be argued that the scent of the fox does not expose him to any danger save the artificial one of a pack of hounds, and that fox-hunting has not been in existence long enough for a less odorous strain to be evolved.

The perfumes of plants, and especially of their flowers and fruits, were till lately left out of consideration as quite unaccountable, or were—what amounts to the same thing—

attributed to a perfectly arbitrary act of Divine will. Now a great approximation has been made to the truth of viewing both the odours and the colours of flowers as means for attracting such butterflies, moths, and birds as may aid in the process of fertilisation. It is further held, on the principle of natural economy, that colour and odour are mutually substitutes for each other. In fact this is what is observed in a multitude, perhaps in the majority, of cases. Many of the most brilliantly coloured and conspicuous flowers are scentless, whilst on the same principle many of the most richly perfumed blossoms are white or pale yellow.

But to this rule there are a number of exceptions which require serious consideration. Not a few flowers of a decided colouration are well known for their sweet smell. As familiar instances I may take the hyacinths, the sweet peas, the stocks and wallflowers, the pinks and carnations, the red rose, the oleander, the auricula, the cyclamen, and the violet. The last-mentioned flower is, however, very inconspicuous, and it is highly probable that it is indebted to its scent alone for the visits of bees. The original types of the auricula and of the wallflower were presumably the light yellow varieties we so often meet with. But though there are white oleanders, their original colour is in all probability red, and the same may be said of the pink and carnation.

We have also to deal with the fact that so many white flowers are totally scentless,—for instance, the large wild convolvulus, and the pear- and plum-blossom. This peculiarity may seem less perplexing if we consider that perfume must be more especially serviceable for attracting night-flying insect visitors, such as moths. Now the white convolvulus, like all its tribe, is a day-opening flower, and is always found tightly folded up at night. The white scentless fruit-blossoms open at a season of the year when few night-flying insects have made their appearance; consequently their fertilisation must depend on the visits of bees and butterflies. The questions then arise—Are any flowers which close at nightfall odoriferous? and, on the other hand, are any species which bloom only in the night scentless? These points can only be studied to advantage in tropical countries, where many flowers open and close at fixed hours of the day, as was shown in the "floral dial" drawn up by Linnæus.

Another interesting circumstance is the number of flowers which emit odours more or less offensive to our sense of smell. Among these rank many well-known garden favourites —dahlias, peonies, the tropæolums (commonly called nasturtiums, tulips, most of the lilies, the geraniums, the French marigold, the sunflower, *Coreopsis Drummondi,* the spotted meadow-orchis, the elder-blossom, and many others. What is the especial function of these evil odours, and what enemies or unwelcome visitants do they repel? It must be noted, in the first place, that in perfume plants the stem and leaves are as a rule scentless, whilst the fragrance resides in the flower alone. Amongst the stench-worts, "if they will allow me so to call them," the whole plant is impregnated with the evil odour, which is sometimes less powerful and striking in the flower than in the leaves and stem. We are apt to conclude that because bees, butterflies, &c., are evidently attracted to some flowers which are pleasant to us, therefore they must necessarily dislike and avoid what to us is loathsome and repulsive. This is a most unsafe conclusion. The beautiful green rose-beetle is no less fond of the sickly-smelling elder-blossom than of the queen-flower whose name it bears. The most beautiful butterflies—"æsthetic aristocrats," as Mr. Grant Allen calls them—will turn from banquetting on the nectar of flowers to sip the drainage of a dunghill, or the juices of a putrid weasel or polecat, which to them may represent sauerkraut and venison. We do not, in fact, see that the ill-smelling flowers are in any signal way avoided by insects, whether enemies, such as the earwig, or those species which may aid in fecundation.

It may, perhaps, be safely said that the majority of unpleasantly-scented plants have flowers of a deep yellow, orange, brownish red, or brown colour, and that blue, pink, rose, lilac, and violet colours are very rare among them, save in case of artificially-produced varieties. A disproportionate number of such plants, further, belong to the family Compositæ, which, extensive as it is, scarcely includes a truly fragrant species. It can scarcely be denied that both pleasant and repulsive odours are respectively connected with certain families of the vegetable kingdom, and that the latter are preferentially correlated to certain colours and flavours.

IV. AGRICULTURAL POSSIBILITIES.*

By An Old Technologist.

THE appearance of a second edition of M. Ville's important work naturally leads to the discussion of some of the momentous questions raised by the author, and which have certainly not lost any portion of their interest since first propounded.

Agriculture, as we are told, or rather as we see, is in England in a most unsatisfactory position. A series of years wetter, colder, and windier than the average have rendered farming not merely an unremunerative, but a positively ruinous occupation,—a most serious state of affairs if we reflect that, after all the advance made in manufactures, the larger part of the national capital is invested in the cultivation of the soil. If that capital from year to year brings in no returns, and is even diminished by losses, it would be an insult to the common sense of my readers were I to expound at length what must be the ultimate result,—a result rendered the more certain by the fact that we no longer hold that unquestioned manufacturing and commercial supremacy which we once thought was, and must be for ever, our own. Were it not for the introduction of food in ever-increasing proportions from abroad, especially from the United States, we should—*e.g.*, in the latter part of 1879 and in 1880—have experienced what may be mildly called severe scarcity. But the method by which we have escaped this scourge has not been an unmixed benefit. To appreciate this consideration we need only look at what may be called the agricultural dilemma. The first condition of national prosperity—or I might rather say national existence—is abundant, and therefore cheap, food. But food may be too cheap for the interests of the producer. If his crops are ruined by increasing barrenness of soil, by unfavourable weather, or if prices are driven down below the remunerative point by foreign competition, the cheapness is to him no boon. The interests of the consumer and the producer can only be reconciled by enabling the latter to produce larger and better crops at a less outlay; this is the great object of M. Ville. Addressing more immediately a people who enjoy a better climate than do we,—that is, who can reckon with a nearer approach to certainty upon suitable weather for the maturing and ingathering of the harvest,—he naturally fixes his main attention upon appliances for increasing the productivity of the soil. He points out the curious and unwelcome fact that the progress of agriculture has not in France (and the same holds good in England) been at all proportionate to the increase and spread of manufactures. The manufacturer, indeed, enjoys certain advantages unknown to the farmer. If he sees fit to double his production he need only erect more powerful machinery and increase his number of hands, and he generally finds that by so doing his returns increase more rapidly than his outgoings. Not so the farmer: an increased quantity of labour often has no appreciable effect upon the returns at all. Improved manuring, as M. Ville advocates, will no doubt in the long run increase the amount of food to be extracted from the soil, but the uncertainty of the seasons forbids us to calculate upon this result as a matter of certainty for any given year. It has even been asserted that the rudest agriculture, where the seed is simply committed to a virgin soil, without manure and with little tillage, is the most remunerative where land is cheap and labour scarce, the returns, large or small, being almost entirely profit. This method of cultivation is of course quite out of the question in modern Europe.

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* On Artificial Manures, their Chemical Selection and Scientific Application to Agriculture. By M. Georges Ville. Translated and Edited by William Crookes, F.R.S. Second Edition. London; Longmans and Co.

But beyond the peril to the farmer of American competition, there lies a further and more serious danger to the entire community in England, France, Germany, &c. In what position shall we be when that competition ceases, if unable to produce our own food? Yet that time must assuredly come, and is every day drawing nearer. All the civilised portions of the earth are becoming more populous, and therefore require an increased amount of their produce for home consumption. At length the time comes when they begin to import food. The child just born may live to see the time when the United States will have nothing more to spare for Europe. This consideration should be stronger than all others in stimulating the nations to improvement in agriculture.

There are of course two very distinct directions in which minds of respectively different natures may look for the means of meeting the growing difficulty. Some, like the present writer, may fix their hopes on mechanical, physical, and chemical invention. Others, I fear the more numerous class in England, will seek relief for the farmer and plenty for the community in the ways of political and social agitation. The attention of this second class may perhaps be usefully directed to a certain anomaly which weighs heavily both upon the farmer and upon the consumer of agricultural produce. It is this: the retail price of manufactured goods of all kinds is approximately regulated by the law of supply and demand; but as regards the natural produce of the earth, especially articles of food, this is not the case. Prices do not fall as the supply increases. A ring of middlemen have thrust themselves in between the consumer and the producer, and create artificial scarcities even by the destruction of perishable goods. Is this to be still tolerated?

Turning now from these introductory considerations we come to the main ideas of M. Ville's work. He maintains that four constituents only require to be supplied to arable lands in order to maintain, and even increase, their fertility,—that is to say, nitrogen, phosphoric acid, potash, and lime. He fully admits that plants require also other elements for their growth, such as hydrogen, oxygen, carbon, magnesia, iron, sulphur, &c. But he maintains that all these bodies are supplied in superabundance by the air, the water, and the soil, and their special presence in manures is therefore needless. The four more important principles he supplies in certain specified states. Thus nitrogen he gives by preference either as a salt of ammonium, generally the sulphate, or as a nitrate of potash or soda. In these states it is at once ready for assimilation by the plants, and is not liable to be lost by fermentation and evaporation. With nitrogen in organic compounds—*e.g.*, in wool-waste, hair, blood, fish-refuse, &c.—the action is not immediate. Decomposition must take place before nitrogen in such states is available as plant-food, and if such food is immediately needed time is lost. Further, during the decomposition of nitrogenous organic matters a considerable proportion of the nitrogen—according to M. Ville about 30 per cent—escapes in the free state, and is lost.

But whilst our author is at one with all other agricultural chemists in holding nitrogen essential for plant-growth, he differs from his colleagues by maintaining that leguminous plants, peas, beans, and lucerne, can absorb and assimilate the free nitrogen of the air. He finds that such crops are not appreciably benefitted by ammoniacal manures, and that generally speaking it is sufficient if one-half the nitrogen which is removed by crops is returned to it in the form of fertilisers. He asserts that a crop of lucerne yields per acre 264 lbs. of nitrogen over and above what can have been furnished by the soil. The ammonia and the oxides of nitrogen present in rain-water are obviously insufficient to account for such a surplus. But, on the other hand, repeated attempts have been made to verify experimentally this supposed assimilation of free nitrogen by plants, and the result has been in every case negative. Some undetected source of error must therefore have been present, either in the experiments of M. Ville or in those of other chemists of eminence, many of whom investigated the question without any reference to his views.

Phosphoric acid M. Ville prescribes in the form of superphosphate; whether he considers that it is equally beneficial if combined with bases other than lime, such as potash or magnesia, it does not appear.

Potash he recommends in the forms of nitrate, sulphate, or potassium chloride, and here, as in the case of phosphoric acid, he insists on restoring to the soil, year by year, as much as has been removed by the crops. So far, therefore, he agrees substantially with the views of other chemists on the inorganic elements of plant-food. He differs from them in the importance which he ascribes to lime. In every one of his manurial formulæ, no matter for what plant it is intended or to what kind of soil it is to be applied, gypsum—sulphate of lime—is present. The gypsum which he thus prescribes is, further, in addition to that formed in the manufacture of the superphosphate, and which amounts to 110 for every 100 lbs. of pure tricalcic phosphate which has been used in the manufacture. It is also independent of the lime existing in the superphosphate in combination with phosphoric acid. M. Ville represents this unusual addition as having been proved itself in his experiments distinctly advantageous. But Messrs. Lawes and Gilbert in their experiments find gypsum a mere diluent. No one, of course, disputes that lime is for most plants an absolute essential, but in many soils it is present in quantities varying from 15 up to 90 per cent. Surely such a supply ought to be sufficient. If it be replied that the lime present in the soil exists in the state of carbonate, which is but very slightly soluble in pure water, it must not be forgotten that the water of rain and dew contains a supply of free carbonic acid, and is thus enabled to hold the carbonate of lime in solution. Besides many soils contain lime also in the state of sulphate. M. Ville, in maintaining that the other mineral constituents of the plants, including of course magnesia, may be dispensed with in artificial manures, asserts that even "the worst soils are superabundantly provided with them." If this is the case, either magnesia is more abundantly present in the soil than lime, or the most important crops require it in a much less proportion. Neither, however, of these two suppositions is correct; even in soils derived from the decomposition of dolomite lime is found in a larger proportion than magnesia. And in not a few crops magnesia predominates over lime precisely in that part of the plant which is least likely to be returned to the soil. Thus in 1000 lbs. of the ashes of the grain of wheat, which in the ordinary course of things is sold, and ultimately finds its way into the sewers, there is found, according to Prof. Johnston, 120 lbs. of magnesia as against 28 of lime. But in the ash of the straw of wheat, which is very much more likely to be returned to the soil, there is only 39 lbs. of magnesia to 67 of lime. In the grain of barley, oats, rye, and maize, and also in beans and turnips, magnesia predominates. I do not therefore see how we can avoid the conclusion that the magnesia of arable lands must be more rapidly exhausted than the lime. General experience, in England at least, has certainly not confirmed the value of gypsum except for certain specific crops, such as clover, peas, beans, &c. Grain-crops have not received any appreciable benefit from its use.

The author fully recognises the low value of humus as a fertilising agent. Indeed, except as a means of rendering the soil more able to absorb and retain moisture, vapours, and gases, such as ammonia, and of supplying carbonic acid to effect the solution of carbonates of lime and magnesia and certain phosphates, few chemists will doubt M. Ville's opinion that it is without any direct utility.

I may perhaps here be allowed to refer to a point in which the experience of gardeners, nurserymen, and florists is at variance with the teachings of agricultural chemistry. The former lay much greater weight upon the physical condition and the texture of the soil than do the latter. Thus the florists' sheet-anchor is "loam." By this term he understands not the "loam" of the farmer, but simply the top spit of old pasture-lands, pared off and laid in a heap till the roots of the grass, &c., have rotted away. Now there needs no proof that the chemical composition of such "loam" must vary greatly, according to the geology of the district, the manures which may have been applied, &c. Yet I have never seen, in any treatise on floriculture, reference to these important distinctions. I cannot help thinking that if gardeners were to pay greater attention to the chemical requirements of their crops their results would be improved.

The main point in M. Ville's work is his most successful attempt to show that chemical manures, if properly selected and applied, are more efficient and cheaper than farm-yard manure. This he proves by a perfect multitude of experiments made by different persons, in various parts of France, and upon soils of very different quality. Almost without exception a better and a more remunerative crop was obtained with the chemical manure. Farm-yard manure contains on an average 80 per cent of water, and, further, about 13 per cent of woody fibre and 4 per cent of silica, so that the really useful matter is included in the narrow limits of 3 per cent. Thus the farmer, in order to apply to his land 3 lbs. of matter which is needful, has to cart and spread 97 lbs. of what is valueless.

According to M. Ville there are in 1 ton of farm-yard manure, roughly speaking, 8¾ lbs. nitrogen, 2⅜ lbs. phosphoric acid, 8¾ lbs. potash, and 17½ lbs. of lime. If with most English agricultural authorities we affix no special value to lime, we shall have, say, 20 lbs. of really useful matter! This tiny speck of gold in a mountain of rubbish, so to speak, is, according to present prices, worth 10*s.* 6*d.* Consequently whenever farm-yard manure, stable manure, &c., cost more than this sum, including the expense of conveying to the field and spreading, their use involves a direct loss.

A further disadvantage of farm-yard manure is that its composition cannot be modified at will to suit the requirements of different crops or different soils. A larger or a smaller dose may be given, but the respective proportions of potash, of phosphates, and of nitrogen are not under control. With chemical manures the intelligent farmer can regulate these proportions to a nicety. If he finds that any particular field is sufficiently supplied, say, with phosphates, but is deficient in potash and nitrogen, he can give it a supply of the two latter without being compelled at the same time to add what is not needed.

This reminds me of a very common error to which Mr. Crookes adverts in a footnote. It is not uncommon to hear some such advice given to farmers as this:—"Do not buy chemical manures, but rather some good feeding stuff." This admonition is a survival of the old superstition (for no better name does it deserve), that matter by passing through the digestive system of an animal receives, in some occult way, an efficacy as plant-food which it did not possess before. It is all very true that by giving an animal more nutriment than it can assimilate, its excrements will have a higher manurial value. But there is a first loss in the animal; the whole of the nitrogen swallowed is not recovered in the form of beef or mutton sold, *plus* the liquid and solid excrements of the animal. When the excrements are collected together and decompose, a second and more important loss takes place, some of the nitrogen escaping as ammonia and a further portion as free nitrogen, amounting, as I have already mentioned, to about 30 per cent. Unless, therefore, 100 lbs. of nitrogen in the form of oil-cake, &c., costs less than 70 lbs. in the state of nitrate of soda, sulphate of ammonia, or other nitrogenous manure, the notion of over-feeding cattle to improve their excreta as manure must be a financial mistake. Further, 1 ton of sulphate of ammonia contains as much nitrogen as 4 tons of good linseed cake.

M. Ville shows that there are cases when a crop which has suffered from a severe winter requires to be stimulated in the early spring. This is easily effected by means of a top-dressing of chemical manures, whilst farm-yard manure cannot be readily brought to bear, and even if applied its action is not immediately manifested.

It must not, however, be supposed that M. Ville seeks to proscribe farm-yard manure. Where it exists he recommends that it should be utilised, and if it is deficient in any essential principle, such as phosphate, potash, or nitrogen, it may be enriched by adding superphosphate, chloride of potassium, or sulphate of ammonia, as the case may require —a simpler, more expeditious, and a cheaper process than that of over-feeding live stock. Indeed the "feeding stuff" notion involves something very similar to a belief in the creation of power or of matter. One and the same particle of matter cannot do a double duty. If it is deposited on the limbs of an animal as meat, it cannot at the same time enter into and improve the manure heap. M. Ville's recommendations, then, are that all cattle should be fully fed; that all land, arable or pasture, should be perfectly manured, but that no attempt ought to be made to increase the supply of farm-yard manure for this purpose.

It is a noticeable feature in the work before us that the author, though a chemist, does not recommend chemical analysis as a means of ascertaining what the soil of a field requires to fit it for some particular crop. He argues that, though analysis informs us what is the proportion of any given constituent in the soil, it does not show whether such constituent is in an available condition. If we extract the soil with an acid we dissolve out compounds from which, as they exist in the soil, the plant can derive no benefit. If we merely lixiviate with water we leave untouched matter which the plant, by means of the prolonged action of carbonic acid, is able to assimilate. As an instance, on treating the soil of his experimental field at Vincennes with hydrochloric acid, the author found phosphoric acid in the proportion of 1581 lbs. per acre. On lixiviating with water the quantity obtained was only 25 lbs., but if beet-root is cultivated upon this land for three consecutive years it extracts from the soil 132 lbs. of phosphoric acid ! Hence the author recommends, as a more practical and decisive method of learning the condition of the soil, the systematic formation and use of trial plots.

It is in these days something remarkable that M. Ville proposes no method of utilising the immense amount of plant-food which, in the form of human excreta, is daily finding its way into the rivers and the sea. He seems to consider the supply of nitrogen, of phosphates, and of potash practically unlimited. I cannot, however, help remarking that the problem of converting the free nitrogen of the air on commercial terms into ammonia, though possibly soluble, has not yet been solved. It is hardly safe to discount the results of a merely probable invention.

We have frequent references to irrigation as an anciently known means of fertilising the soil ; but these passages deal merely with the flooding or inundation of water-meadows during the dead season of vegetation, and have nothing in common with the modern scheme of sewage irrigation applied continuously.

M. Ville, like many of his countrymen, is not a little exercised on a subject intimately linked with the national supply of food. France, more perhaps than any other country, has sought to keep down superfluous mouths ; she has, so to speak, capitalised the funds which would have been required for bringing up a more numerous population, and she is now far from satisfied with the results. The fact remains that a Malthusian nation, or a Malthusian class in a nation, must simply efface itself unless similar principles were universally adopted. All schemes proposed by man to stamp out the struggle for existence in his own species seem doomed to failure.

Setting aside M. Ville's questionable views on the assimilation of free nitrogen and on the universal necessity for gypsum, his teachings must be regarded as of the highest value both in his own country and on this side the Channel.

V. WILL-O'-THE-WISP AGAIN.

By W. Mattieu Williams.

THE article on "Will-o'-the-Wisp" in last month's "Journal of Science" (p. 447) reminds me of my own experience, which, although by no means recent, is clearly impressed on my memory, and the impressions confirmed by reference to the diary which I very scrupulously kept in those days.

In the course of a walk from Genoa to Florence, long before there was any railway communication, I started on the morning of November 30th from Carrara, walked on through Massa to Pietra Santa. Here, as my diary states, I went on towards Lucca, and as it was late I enquired for an inn, and was told that I should find one on the roadside a mile distant. I walked on 4 or 5 miles farther, until it was quite dark, and found no inn or any other human habitation, the road being on a dead level with rice-fields covered with water on each side.

At last I saw what appeared to be the lights of a village in the distance, and after another half-hour's walking was surprised to find them still as distant as ever. I pushed on nevertheless, but got no nearer to the village. The idea of Will-o'-the-Wisp had not suggested itself; I merely regarded this as an instance of deceptive distance, until at last it became quite incomprehensible. Then I stopped and deliberately examined these lights, found that they were curiously flickering, and quite unlike the lights from house windows: further scrutiny showed that the idea of great distance was a delusion,—that they were faint, ghostly lights, at only a moderate distance, but which was very difficult to estimate. Then their true character suggested itself, and I turned round and found them behind me as well as in front. I walked on, and they preceded and followed me in a circle broken only by the road. I had already noticed this, which strengthened the first delusion, as they appeared like lights from houses on each side of the road.

Their brilliancy was less than is indicated by the descriptions I have read, less than that of the flame of a spirit-lamp at 20 yards distance. There was a multitude of them, all about 5 feet from the ground. I now suspect that the height was that of my own eye, but did not think of this at the time, or might have made the experiment of stooping and putting my face to the ground, which experiment I now suggest to others who may have an opportunity of investigating the mystery.

None of the explanations quoted in the paper above referred to are at all satisfactory.

It appears to me that I was surrounded by a faintly luminous waving mist,—its luminosity so faint that it was only visible when a certain depth or thickness was presented in the line of vision ; that at much greater depths than this the mist was opaque to such faint light, and therefore the luminosity presented itself as a ring with an inner radius corresponding to the depth necessary to render it visible by accumulation, and an outer radius limited by the opacity of the mist. The dancing fluctuation was probably due to the unequal diffusion of the luminous matter.

If this is correct its visibility only at and about eye-level (the lights appeared about a foot in perpendicular height) is explained, as on looking obliquely downwards there would not be a sufficient depth of the luminous matter between the eye and the ground, and on looking upwards the region cf its diffusion would be penetrated,

I finally reached the town of Viareggio, and there learned that I had taken the wrong road after leaving Pietra Santa, and the next morning I walked back and then struck inland over the hills.

The absence of human habitations was fully explained. The road I had taken passed through a most pestiferous part of the Maremma, which is even more deadly than the Pontine Marshes, though of smaller extent.

If the modern theory, which attributes the poisonous action of the malaria to germs of *bacili* or *bacteria*, or similar microscopic organisms, be correct, this faint phosphorescence is easily accounted for. We have only to suppose these to be like so many of the lower forms of organic life which are phosphorescent. The ocean is so filled with these at times that the wake of a steam-packet is a belt of light of at least a hundred times greater luminosity than that which I saw over the Maremma.

It just occurs to me, in writing, that there may be some connection between these phenomena and the strange stories that are told of a luminous aura floating over death-beds, and which poetical people have attributed to the uprising of the departing soul. At the risk of being denounced as a materialistic brute I cannot help suggesting that this luminous aura (if it really has appeared) was due to insufficient ventilation, permitting the stagnant accumulations of pestiferous emanations from the diseased body of the departing saint.

VI. EXPERIMENTATION IN BIOLOGY.

By Oswald Dawson.

> "Another field, as yet almost unworked, lies open to enquiry. . . . Organic Physiology has not afforded such assistance to Zoology as it might have done if it had been less exclusively forced into the service of practical medicine. An immense number of questions bearing the highest general scientific importance lie open to physiological enquiry in the vast number of different species of animals."—Karl Semper.

> "That introduces a new element into the question, . . . which leads us necessarily into very serious conceptions and questions of the nature of our whole being and moral responsibilities."—Henry Wentworth Acland.

THE above quotations sufficiently indicate the purpose of this Article: a multiplicity of circumstances combine to render prolonged delay in discussing the subject a matter for rebuke; certain of these may be enumerated,—viz., a short time ago an Association was formed for the advancement of *medicine* by research: in the event of this Association effecting the repeal of restriction biologists are free to investigate, thus availing themselves of liberty and publishing details at a time when defeat has rekindled the energies of the "anti" leagues. The latter will inevitably *then* distinguish between medical and biological vivisection. Consequently they will postpone further efforts to abolish or limit anew the former class, till the latter is suppressed; meanwhile medicine will be unconcerned to rescue its present ally, and biology will again be in the position it is to-day. This "Journal" alone has conspicuously recognised and insisted upon the claims of biological vivisection, and made exertions to secure those claims; but co-operation not forthcoming upon renewed invitation, it is abandoning its endeavours, save indirectly by aiding an association with a distinct ultimate object. Reflection will show this policy, being so readily capable of false interpretation, as hypocritical concealment of real motive, to be ill-judged in the extreme, while the result of such coalition has been already traced above. Alliance is strength, but simulation of the ally is a tactic not enduringly strong. This policy being shown unwise, we must choose between reticence and the institution of a closer enquiry, for it is evident that what has been already said by this "Journal" has been insufficient to create sufficient agitation, while Dr. Acland's thrice-renewed effort to bring into prominence the distinction between medical and non-medical vivisection, before the Royal Commission, led to no further questioning on the subject, which accordingly fell into subsequent oblivion, the exertions of scientists and scientific journals being occupied in defending medicine, and the anti-vivisectionists admitting the matter "a little beyond" their comprehension: in that assertion there was more significance than appeared to them; the subject is a *little* beyond them, but not far beyond; the only visible indication of the remotest appreciation of the matter is to be found in the manifestation of a very peculiar feeling towards the English biologists, which, to take but one instance, so far enables the editor of the "Spectator" to overcome any compunctions in expressing the hope, on a vacancy occurring in a University chair, that Prof. E. Ray Lankester will be an unsuccessful candidate. But in deciding which course to adopt—reticence or renewal of the subject—a nobler motive must influence Science than the fear whether zoophily is likely to arouse soon; if it be that "another field, as yet almost unworked, lies open to enquiry," and that such enquiry is expedient, English biology must sketch its programme and remove the obstacles to the fulfilment of the task it has pronounced its duty. But we shall be led "into very serious conceptions and questions of the nature of our whole being and moral responsibilities," and the reader should remember we are here discussing the question of physical pain; he must bear in mind, too, how little can we form a conception of suffering except at the moment of endurance. These considerations apply to those also who are discussing medical vivisection in this and other journals at the present time, but their task is comparatively simple,—it is to weigh present infliction of pain with future alleviation of *the same*,—a mere question of transference in fact: no such translation is possible with us; pain is inflicted, but a "new element is introduced" in the benefit contemplated, such benefit, again, being infinitely more remote.

"Our ignorance of the laws of variation is profound." "The causes and conditions of variation have yet to be thoroughly explored." These sentences epitomise an extensive portion of a literature supported from month to month by contributions from a heterogeneous assemblage of persons who discover their priority of mission to detect the oversight of Darwinism, whose negation of their interpretations of that system is presented to them in the very works they criticise, in the two passages cited above, to which others might be added. Favourably contrasting with the afore-mentioned is a distinct class of men who hold sufficient trial has not been accorded to factors in variation specified by other writers, and treated anew by, but consigned to subordinate positions in the system of, Mr. Charles Darwin.

One of these factors is known as "external conditions." Mr. Darwin devotes a chapter to the subject in the "Variation under Domestication," and a paragraph or so in the "Origin of Species." The subject commands a fuller respect in Mr. Herbert Spencer's system, while more recently special attention has been paid to the question, the various influences having been classified, and more or less copious examples cited under each section, in a volume of which we give the full title and a condensed account of such of the subject-matter as bears upon our question :—"The Natural Conditions of Existence as they affect Animal Life," by Karl Semper. The influences recognised are food, light, temperature, air, and water, still and in motion, living organisms, and miscellaneous. Prof. Semper discusses largely the influence of natural conditions, which it would be useless to recapitulate here; he likewise records many experiments as to the influence of artificial conditions; but these, it happens, are mostly of so trivial a nature that we may omit their consideration also. Several experiments refer to vertebrate animals, and thus are most intimately related to our enquiry: these are as follows :—The experiments of John Hunter and Dr. Holmgren on the transformations occurring in the coats of the stomach of birds, also mentioned by Mr. Darwin; the enclosure of Amphibia in masses of gypsum; the darker colouring of frog's skin following deficiency of food; the experiments of Pouchet on the chromatic function in fish, proving the conducting function of the sympathetic system of nerves—he severed the connection of certain of these with the spiral nerves, and produced a zebra-like marking on one side of the fish, the chromatophores of the side in relation to the uninjured nerves, which, being intact, conducted the optical stimulus as normally, retaining their natural hues as regulated by the reflection from surrounding objects. In the section on the accommodation of water-breathers to breathing air, reference is made to the experiments of Jobert on the swimming-bladder of fishes, and, elsewhere, to those of Moreau and Jouriet. Some highly-valuable experiments by the author are detailed, entailing great inconvenience upon frogs, whereby it was established that a solution of 1 per cent of salt in the vessel of water tenanted by the animal was without any effect upon it: this was ascertained by observing that a frog so situated lived as long as one placed in fresh water; it was found that twice that percentage proved fatal in seven hours, and so on: by tying the animals to sticks in a special manner swallowing water was prevented, and of course the animals died of starvation in those cases where fatal osmotic action had not supervened. Claude Bernard and Paul Bert have made experiments in the same direction. But the main feature (for our present purpose) of Prof. Semper's volume is not the individual importance of the experiments given, these being comparatively insignificant from a zoophilist point of view, as the especial experimental character of the subject according to the views of the author; thus no less than (literally) a score of times does Prof. Semper lament the absence of experiment, suggest practical investigations on certain lines, complain about the prevailing fashions in modern zoology, the insufficiencies of our laboratories, and the forcing of Physiology too exclusively into the service of Medicine: he distinguishes a Physiology of *Organs* and a Physiology of *Organisms*, and thus (in part) anticipates Prof. St. George Mivart, to whom Biology owes gratitude for the most happy introduction of the term "Hexicology."

The announcement, a few years ago, as a "forthcoming" volume in the same series as the work of Prof. Karl Semper, by Paul Bert, on "Forms of Life and other Cosmical Conditions," warranted the anticipation of an original and masterly essay in this department, for M. Bert is well known to be experimentally acquainted with the Vertebrata from fish upwards, while he has not despised Invertebrates as low as Infusoria, but, judging by subsequent catalogues, this hope must be abandoned. But this circumstance and the fact that so few severe experiments are recorded in Prof. Semper's volume do not imply that little has been or may be done in the investigation of conditions and their influence. To renew the case of food, for example, Spallanzani accustomed a pigeon to meat, an eagle to a diet of bread. Voluntary change of diet occurs sometimes in Nature, reindeer having eaten lemmings (Brehm), horses and oxen entered water to catch fish (Burdach), parrots taken to blood-sucking, and so on. Again, not only do morphological changes occur; thus the gastric juice of herbivorous animals is normally less active than that of carnivorous species, but by causing an herbivore to absorb peptogens the stomach may be rendered functionally carnivorous, experiment showing that peptones prepared by them, and injected into the stomach or blood of a carnivore, are assimilated, and not passed into the urine (see Letourneau; Biology, "Library of Contemporary Science"). The experiments of Réaumur, who introduced pieces of meat enclosed in perforated metal tubes into the gizzards of birds, and found they were dissolved,—and of Spallanzani, who performed artificial digestion by employing gastric juice from the living body,—upset the trituration theory of Borelli, Bœrhaave, and Pitcrairn, which had itself displaced the fermentation theory of Hilmon. By experiment we know that limitation of diet to one vegetable may kill a rabbit in about a fortnight; but as such condition of poverty has perhaps never occurred in Nature, the experiment loses its value for our purpose: this remark largely applies to the starvation experiments on the higher animals by Chossat, but those on Amphibia and snails are not without interest; thus a snail loses only one-eleventh part of its weight after a six weeks' fast, according to Burdach.

Prof. Semper devotes a chapter to "Other Conditions." The chief of these are pressure and electricity, but observations from Nature are alone recorded. Nevertheless the study of the effects of pressure is valuable in connection with the environment of fish; for instance, M. Cailletet erected apparatus in which fish were placed under a pressure of 400 atmospheres. The effects of electric shocks upon animals have been made known to us by Dr. Richardson's researches: ecchymosis, loss of hair, &c., may result, though it is doubtful, as Prof. Semper remarks, whether any other effect is produced in Nature by electricity save death, while here individuals, not species, are exterminated. Experiments have been made with regard to other influences, especially the action of poisoned atmospheres: the scientific value of these must be sought in the success attending any attempt to accustom an animal permanently to reside in a similar medium. Experiments on the effects of ozone have been chiefly interesting as showing the peculiar relative powers of endurance in various animals: thus mice live longer than rats, rabbits than guinea-pigs; but enough has already been done to establish the truth that closely allied or distant species may be differently affected by the same influence, and the investigation now awaiting is the cause of each such difference. Anyone making a thorough investigation of the cave Amphibia, or other animals, might possibly be able to turn to account the experiments of Fubini on the relation of light and body-weight ("Journal of Anatomy and Physiology," October, 1875). In the light, frogs with eyes lost more than double in weight in proportion than blind ones, but in the dark both increased in weight, the blind ones less than their fellows.

"If Lamarck could have shown experimentally that even races of animals had been produced in this way, there might have been some ground for his speculations; but he could show nothing of the kind, and his hypothesis has pretty well dropped into oblivion, as it deserved to do." Such was the judgment pronounced by Prof. Huxley some years ago, and, though extracted from a lecture in the republication of which the author volunteers to accept no further responsibility than the accuracy of statements, the practical verdict is so rigidly in harmony with the spirit of the age, and so exquisitely adapted as a test for the further discussion of our question, that we needlessly delay in apologising for quoting it. Now it happened Lamarck advanced his views not as the thoughts of a precocious, fictitious reality,—"precocious" as too wise for his age, and a "fictitious reality" being, in truth, the *alter ego* of the author (De Maillet),—but in a "Philosophie Zoologique." Of this book Mr. Samuel Butler has recently presented English readers with a selection and translation of a copious number of passages bearing upon Evolution, and in various countries attempts are being made to establish the claims of Lamarck as an originator of a theory of Evolution worthy of considerable respect: thus we constantly hear of the "Lamarckio-Darwinian" hypothesis; France is naturally anxious to recognise all due merit; Prof. Cleland, in this country, detects much in modern theories to be Lamarck rendered anew, but unacknowledged. Additional proof is needless to show that the deserved oblivion of Lamarck is daily growing less manifest, yet no parade of quotations can fitly be substituted for an array of facts: new needs, no matter whether arising from variations in the environment or from any variation of disposition on the part of the animal, give rise to new efforts, and efforts to modifications. The power of emergency is well known; how ordinary speed can be quadrupled, leaps attempted without hurt, and tales (for several see "Night Side of Nature") are on record of bedridden invalids, lingering life away, who have jumped up and been permanently cured at the cry of "fire." Necessity is the mother of invention in human affairs; what is it "the mother" of in animals? Animals would jump and endeavour to balance upon a shaking bough, if food were stored there, rather than hunger; birds would dive into a foot of water if clear enough to see grain at the bottom, food not being obtainable in other parts of the room; leaping from the ground to a bough is the first step towards leaping from one bough to another, and diving into one foot of water is a preparatory lesson to two, three, ten feet: by employing suitable apparatus for fixing to the animal, compulsory locomotion in water—the hind limbs being rendered incapable of action, with a view to reduction in the course of generations—might effect considerable modifications; the enforcement of the erect posture by quadrupeds, at the same time, entailing total disuse of the fore limbs, not by severing the nerve, might be impracticable; nevertheless appliances could be devised to render the lower primates habitually erect.

One experiment suggests another, and each other one several more, and the patience, time, and expense involved is surpassed only by the value of the possible result. Of course negative results would not repay the research, as maintained in the case of toxicological experiments.

A knowledge of the plasticity of living structures is of fundamental importance under the present aspect of Biology; though neglecting reference to natural phenomena or experimental verification, popular conception may ill appreciate its extent; realisation, however, is facilitated by an appeal to Surgery,—what seems more resistant than bone? Yet varicose veins leave their impress on the tibia; aortic aneurisms piece bone; articulations are formed anew; luxations obliterate the hollows made by tendons now removed from their normal situation; and so forth.

Ten years ago Dr. Ainslie Hollis wrote a series of papers on "Tissue Metabolism," to the "Journal of Anatomy and Physiology," the main discovery being that there prevails "a general correspondence throughout the animal kingdom in the sequence of phenomena observable after application of an irritant to living surfaces." Dr. Hollis's investigations in Vertebrate "Tissue Metabolism" related to such harmless parts as the "recently-abscised tail of a decapitated newt." His experiments on the higher Invertebrata were not satisfactory; the chitinous integument interfered in the case of the Arachnida, while in slugs and snails the flow of mucous carries away the irritating matter. Several experiments were made on the earthworm, and eleven on a species of anemone (*Actinia mesembryanthemum*): of these one is of unusual interest; a piece of the animal was excised, and the edges of the wound inverted; some convoluted perivisceral tubes were upon the outer surface: after two days the wound was still unhealed, but upon the application of blistering fluid the wound was closed by the protrusion of a fresh supply of convoluted tubes; these, after a month's interval, underwent complete granular degeneration. How pregnant was John Hunter's phrase "stimulus of necessity"! Must we believe the pseudopodial moneron to be, with manual Man, the prince of inventors?

(To be continued.)

ANALYSES OF BOOKS.

A Treatise on the Distillation of Coal Tar and of Ammoniacal Liquor, and the Separation from them of Valuable Products. By GEORGE LUNGE, Ph.D., F.C.S., Professor of Technical Chemistry in the Federal Polytechnic School, Zurich. London: Van Voorst.

WITH the exception of a treatise published by the author, in the German language, as far back as 1867, and which is necessarily to a great extent out of date, the work before us is the first systematic and complete monograph on one of the most important branches of chemical manufactures.

The author possesses special qualifications and advantages for the task which he has undertaken. He is not merely an able and learned scientific chemist, but he has had most extensive practical acquaintance with chemical manufactures in general, and with this branch in particular. Thus he is, unlike some otherwise very eminent scientific men, fully competent to judge of the coal-tar industry from a commercial point of view. As a special preliminary for the compilation of this monograph he has not merely made a thorough study of the literature of the subject, but he has taken the opportunity to supplement his own experience by personal observations in a series of the largest and best tar- and ammonia-works in England, France, and Germany. He has also been aided by Mr. Watson Smith, formerly his assistant at the Zurich Polytechnicum, and now Professor of Chemical Technology at Owens College, Manchester, a chemist well versed in the treatment of coal-tar products, and by Dr. C. Meymott Tidy.

The resulting work must be pronounced in every way worthy of the high reputation of the author, and calculated to be of the greatest service to the chemical profession, as well as to all persons concerned in the management of tar- and ammonia-works.

One limitation must be noted in the outset. Dr. Lunge does not undertake—what, indeed, within the limits of a single volume would be utterly impossible—to discuss the manufacture of all the almost innumerable bodies known as coal-tar products. He treats merely of the compounds pre-existing in coal-tar, their separation and purification, not of their derivatives. Thus we find here instruction concerning benzol and anthracene, but nothing concerning the preparation of aniline from the former and of alizarine from the latter.

The first chapter of the work treats of the origin of coal-tar, with especial reference to the different quality of the products obtained from the destructive distillation of peat, brown coal, and the bituminous shales, of wood, and of true coal. All these tars are exceedingly complex mixtures, whose several constituents are far from having been thoroughly disentangled. A suggestion is thrown out here, at the very outset, that whereas up to the present day gas has been the main result of the destructive distillation of coal, and the tar a mere by-product, circumstances may possibly arise under which these relations would be reversed.

The author next gives a historical sketch of the applications of coal-tar and its products, from the earliest attempts in this direction made by Becker and Serle (1681), and Clayton (1737), dates, it will be remembered, anterior to the introduction of coal-gas as a lighting-agent. It was not, however, until 1856, the epoch of the introduction of aniline colours, that gas-tar ceased to be a burden and a nuisance. The production of benzol, the raw material for aniline, although amounting merely to 1 per cent of the gross weight of the tar, was for a time so remunerative that it became a commercial article in good demand. Unfortunately the producers of the raw material succeeded in establishing a system which places the tar-industry on an insecure footing. We refer to the contract-system, which renders it impossible for the distiller to buy what he requires from time to time in an open market.

A reaction soon took place in the value of benzol, when the discovery of artificial alizarine gave a fresh impulse to this industry. For the preparation of this important dye the raw material is anthracene, which is now, probably, the most valuable and remunerative of the constituents of coal-tar.

The present condition of the trade is thus summarised by Dr. Lunge :—" In England, where by far the largest quantity of gas-tar is produced, where benzene was discovered by Faraday, its industrial preparation by Mansfield, the first aniline colour by Perkin, and where the conditions are most favourable for the purchase of the necessary chemicals, as well as for the sale of the colouring-matters, the manufacture of artificial dyes has only risen to moderate dimensions. The same has taken place in France. On the other hand, in Germany and Switzerland, the manufacture of coal-tar colours has been established on an enormous scale, so that the tar produced there can only supply a small portion of the benzol and anthracene required, the larger portion being imported from England and France, partly in the form of aniline." This, we cannot help saying, is a state of affairs which surely demands very grave consideration. If we have lost a manufacture for which we have such decided natural advantages, what certainty have we of retaining others where our advantages are smaller ?

The quantity of coal-tar produced in all Europe is, according to Dr. Weyl, 350,000 tons, of which the larger part is obtained in England, 50,000 tons in France, 15,000 in Belgium, and half that quantity in Holland. For Germany Dr. Weyl gives no figures, but, according to the "Chemische Industrie," the annual quantity there distilled is 37,500 tons. According to Mills, as far back as 1874 the weight of coal consumed in the United Kingdom, for the manufacture of gas, is 10,000,000 tons, which would represent a yearly production of about 450,000 tons of tar.

The production of tar at the gas-works fluctuates according to the quality of coal employed, and not less according to the temperature at which the retorts are worked. According to a table here inserted the yield ranges from 4 per cent of the coal up to 6, the quality also being far from uniform.

In connection with this subject our attention is drawn to the prospect of utilising the very large quantity both of tar and ammonia which at present are wasted in the conversion of coal into coke for metallurgical purposes. Attempts, it appears, have been made in this direction since 1768. Dr. Lunge, whilst noticing several of the processes proposed, does not commit himself to any statement as to their remunerative character. He considers, however, Dr. Angus Smith's report on the modified Knab process, as carried out at Bessàges, as rather too favourable.

A notice is also given of the proposal to obtain some of the most important constituents of coal-tar by decomposing the heavier oils (at present of little use) of the petroleum and paraffin oil-refineries. Here there is room to hope for results which may emancipate the tar-distiller and the dye-manufacturer from their present dependence upon the gas-companies.

In the second chapter Dr. Lunge treats of the properties of coal-tar and its constituents, of which he enumerates no fewer than 114, arranged under the heads of hydrocarbons, oxygenised compounds, sulphuretted compounds, and nitrogenised compounds. We find the remark that not a few authors of standing —such as Bolley, Wurtz, Girard and Delaire, &c.—have stated the specific gravity of coal-tar as being only equal to, or even below, that of water. In reality it ranges from 1·10 to 1·20.

The next chapter is devoted to the applications of coal-tar without distillation, such as for gas-making, for heating, for preserving stones, brickwork, metals, and wood, as an antiseptic (it has been used, in conjunction with lime and magnesium chloride, for the treatment of sewage), for the production of lamp-black and of printing inks.

In the fourth chapter we find an account of the first distillation of coal-tar, embracing dehydration, previous purification, the construction and setting of stills, condensing apparatus, filling and firing the stills, the principles and different systems of fractional distillation, with the separation of ammoniacal liquors, light oils, carbolic, creosote, and anthracene oils, running off the pitch, and testing the tar.

The following chapters treat in succession of pitch, of anthracene oil, the sublimation of anthracene, and an account of its properties and analysis; of creosote oil, carbolic acid and naphthalene, light oil and first runnings, the rectification by steam and the final products, and ammoniacal liquor. Into these sections, which are written with thoroughness and care, want of space does not allow us to enter.

A very valuable feature of this work are the figures of plant and apparatus, which are very clear and carefully drawn, in most instances to scale.

The work must be pronounced a boon to chemical industry, similar in nature to the author's classical treatise on the manufacture of sulphuric acid and alkali.

The index is fairly copious and correct wherever we have tested it, and the getting up of the book is quite satisfactory.

Vignettes from Nature. By GRANT ALLEN. London: Chatto and Windus.

MR. ALLEN is deservedly well known as one of the happiest expounders of the great theory of Evolution. Few have done so much as he in winning for it the favourable attention of educated outsiders, especially among the artistic and literary world, and in lulling to sleep the watchful dragons of British Philistinism. At the same time, by his work, "The Colour Sense, its Origin and Development,"* he has rendered good service towards solving some of the most interesting problems which we encounter in the animal and vegetable kingdoms. The work before us, as the author tells us, "forms the record of a single summer's stray thoughts on Nature, from an easy-going, half-scientific, half-æsthetic standpoint." Here, as in all his writings, Mr. Allen shows himself as an orthodox Darwinian, not in the popular, but in the stricter sense of the term, to-wit, a believer in Evolution as effected by the processes of Natural and Sexual Selection. He claims for his essays nothing more than to be "popular expositions of current evolutionary thought," and hopes that "they may perhaps do a little good in spreading more widely a knowledge of those great biological and cosmical doctrines, which are now revolutionising the European mind," but which are being less rapidly assimilated by the national mind here in the native country of Darwin than is the case in lands more remote. The author's modest anticipation is, we think, likely to be more than fulfilled.

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* Journal of Science, 1879, p. 393.

The first of these essays, on "Fallow Deer," touches on two controverted points: Were fallow deer first introduced into Britain by its Roman invaders, or are they, as Mr. Allen inclines to think, a part of our indigenous fauna? Another disputed question is concerning the beech tree. The author refers to the time when England was clad by one almost unbroken sheet of oaks and beeches." Now Cæsar, in his Commentaries, notes the absence of the beech in that limited part of England which he overran. Archæologists have also remarked that whilst the ash and the oak have given names to a multitude of towns and villages in all parts of the Island, very few truly pristine names can be traced to the beech, Buckingham being one of the few exceptions.

Reference is made to the wild cattle of Chillingham as an interesting survival of our old mammalian fauna; but here, as in other writings on the same subject, it is overlooked that a herd of the same species exists at Lyme Park, near Macclesfield. The sketch of the development of horns in the ruminant animals is beautifully clear and simple. With one passage, however, we must venture to disagree. The author pronounces horns "weapons of rivalry, all but useless against other species." Now, any one who has ever seen, *e.g.*, a bull or a buffalo fighting, whether against human, canine, or feline foes, will hesitate at endorsing this view. With a speed little to be expected from so ponderous an animal, he strikes right and left with his horns through a breadth of nearly four yards, rushing rapidly forwards all the time. The "horn of hart" was, in the days of our forefathers, dreaded alike by huntsman and hound. Two flaws somewhat mar this otherwise pleasing and instructive essay: The author goes out of his way to announce his political creed, and he twice makes use of the cant expression "dumb," as applied to the lower animals.

The essay on "Sedge and Woodrush," calls attention to a circumstance often overlooked by beginners in the study of Natural History, and especially by those unreasonable beings who, without being or seeking to become naturalists at all, insist upon criticising Darwin and his coadjutors. Says Mr. Allen:—"Contrary to the general belief, Evolution does not by any means always or necessarily result in progress or improvement. Nay, the real fact is that by far the greater number of plants and animals are degraded types,—products of retrogression rather than of upward development." By dint of overlooking this truth, first, we believe, worked out by Prof. E. Ray Lankester and Dr. Dohrn, of the Naples Aquarium, Prof. Minot was led to the conclusion that man is not the highest mammalian type.

The chapter entitled the "Hedgehog's Hole," gives an interesting survey of the position, past and present, of the Insectivora.

Here, also, some questions are answered with which the tyro is often perplexed.

In a pleasant sketch of Musbury Castle, redolent of the fresh air and the blossoms of a fine May morning, Mr. Allen calls attention to the local constancy to be noted in the distribution of the fauna and the flora. We are far yet from having mapped out the ranges and occurrence of species, even in this limited and, to the naturalist, poor country of ours. As for the how and the wherefore, they are scarcely yet touched upon. Whilst treating of the Guelder Rose, and proclaiming his dislike of the double flowers of our gardeners, the author reminds us that "the labour of the old-fashioned naturalists has collected an enormous mass of facts as to form and structure; but as to use and function, we have still almost all the work to do." How sad, therefore, that this particular department of biology is so much interfered with and threatened by the hostility of modern sentimentalists.

In the "Heron's Haunt," the author develops his theory that the chromatic tastes of birds seems to get quickened in their daily search for food among the blossoms and fruits of southern woodlands." He seems, however, to place the birds of paradise too exclusively among fruit eaters. Though partially frugivorous, they are like their kinsfolk, the crows and jays, exceedingly fond of insect larvæ,—a class of beings not generally remarkable for brilliant colouration, and often found amidst dull sombre-hued materials.

In a "Bed of Nettles," Mr. Allen gives, in his adherence to the tradition, that nothing soothes a nettle-sting like dock-leaf, to which he, however, adds "philosophy." We have often been nettle-stung whilst poking about after insects in the hedges and ditches, and have from time to time tried the dock-leaf as a remedy; but we never felt any decided benefit, and to this day we are unable to say whether the pain abates more rapidly if the wound is rubbed with dock-leaf or if it is let alone. But there is a great amount of idiosyncrasy as regards this same sting. We know persons who, if "nettled," feel the irritation the next day.

Under the title of the "Carp-Pond," the author traces the wanderings and distribution of the Cyprinoids from their original home in Central Asia. He remarks that we have no Siluroids in England, as our streams are too pure and clear and rapid for them. Surely the purity of our streams is more a matter of tradition than of modern observation, and on the eastern side of England the rivers have never been characterised by rapidity. Their distribution he justly characterises as utterly unintelligible save on evolutionist principles.

Contemplating a Llyn Gwernant trout, a peculiar and strictly local species, found only in one small mountain tarn in Wales, the author makes the strange remark: "I have certain compunctions of my own about the morality of catching a trout for such a purpose," *i.e.*, in order to watch and report upon its specific peculiarities! Our Bestiarian friends, "if they will permit us to call them so," may perhaps be misled by this passage into thinking that they have here found for once a man of sense to sympathise with them. But let them read on, and they will be dismayed. "After all," says Mr. Allen, "it is just as legitimate, I suppose, to catch a fish in the interests of science, as to catch it for the sake of dishing it up at supper in a tempting brown case of egg and bread-crumbs." The account which our author gives of the development of this species is substantially conceived in the spirit of Herr Wagner's theory of segregation. A few trout found their way into the tarn; gradually, as the brook went on carving its way through the rock, access was rendered more difficult. "So, after a while, no more trout could re-inforce the small colony in the tarn, which would thus have room to develop in their own way to suit their own peculiar circumstances, without any cross of fresh blood from the old stock to keep them true to the general type of the race in the lowland rivers." He goes on to say that in such isolated localities, enemies, if any, are fewer in number. In other words, the struggle for existence is less severe, whilst spontaneous variation is more likely to occur from change of food and other external conditions. Whilst recognising this sketch of the probable origin of the Llyn Gwernant trout as having the strongest probability in its favour, we feel an additional interest in noting the close approximation to Herr Wagner's views here made by so decided a Darwinian as Mr. Allen.

We must here, however, close our survey of this pleasing and instructive little book. Not only does it record observations,—it will make observers.

The Life of Charles Darwin, with British Opinion on Evolution. Compiled by G. W. Bacon, F.R.G.S. London: G. W. Bacon and Co.

In analysing this biography of our great naturalist we cannot help noticing that the hostility against him and his teachings, which had of late years greatly subsided, has to some extent been rekindled. M. Moigno has characterised the faint praise of M. de Quatrefages as savouring too much of academical courtesy. Nearer home a writer has sprung up, who, though palpably new to the study of biological science, boldly ventures to lay down the law on this its most complicated and difficult question. It is too much to hope that the case should be otherwise. In England the public is apt to listen with respect to opinions confidently expressed, to arguments and objections difficult to meet because totally beside the question, without insisting that the author should have given the subject any prolonged and careful attention.

The little work before us gives a fair, though brief, biography of Darwin, in as far as it can be furnished from sources generally open to the public. Of his descent from Erasmus Darwin, and of the generally intellectual character of the family, the public is already well aware. But it is interesting to learn that Robert, the father of Erasmus, had some scientific and poetical tastes, and that his wife was a very learned lady. Her husband does not seem to have admired her classical attainments, for he composed a kind of Litany, one verse of which runs—

> " From a morning that doth shine,
> From a boy that drinketh wine,
> From a wife that talketh Latine,
> Good Lord deliver me."

The Darwin race seems to be an admirable instance of heredity. They have almost invariably lived to a good age. For at least four generations the family has been far above the average run of civilised mankind in intellect, and in two instances it has reached the height of that rare attribute, genius. They have repeatedly intermarried with other families of an unusual mental calibre,—a fact which will be at once recognised on noting that both the mother and the wife of the illustrious Evolutionist were descendants of Josiah Wedgwood. Another point to be noticed is their persistence in selecting professional careers. For 260 years, when not country gentlemen, they have been physicians, less generally lawyers, or soldiers. We do not learn that any member of the family has been engaged in trade, nor have they aimed at a parliamentary career or at official position of any kind. They have been men of thought rather than of action, in the ordinary sense of the word.

The life of him whom we call the great Darwin was singularly quiet, and characterised by a philosophic simplicity rare in this age of turmoil, bustle, and ostentation. After his memorable voyage he rarely left his home, and lived mainly in his works. Though a member of several of the principal scientific societies of London, and warmly interested in their welfare, he rarely attended their meetings, save to communicate some of his results, and here, as in all his doings, he showed a most remarkable modesty and an " evident unconsciousness of his own greatness." Self, indeed, with him, was completely merged in his devotion to his subject. He never delivered a public lecture, never filled the presidential chair of the British Association, or of any of its sections. Most singular, he took no part in the great Darwinian controversy, which began in 1859 with the appearance of his great work the " Origin of Species." To all reasonable, candid doubters and dissidents he was ready to reply in an exemplary spirit of patience. Those who assailed him with abuse he left to be dealt with by the numerous and able disciples who—alike in this country, in Germany, and in America—were gathering round him.

The second portion of the little work before us, "British Opinion on Evolution," consists of tributes to the greatness of Darwin paid by men and by journals of the most varied parties and sects, yet all uniting in their appreciation of his genius and of his work. Whether the writers of these official eulogiums worshipped the Darwin of reality, or some picture of him limned more or less according to their own notions of what he should have been, the future must show. The time has not yet come for us to understand all his greatness.

Mr. Bacon's "Life of Darwin" ought to be found in every school-library, and in the home of every thoughtful working man.

A Dictionary of Popular Names of the Plants which furnish the Natural and Acquired Wants of Man in all Matters of Domestic and General Economy, their History, Products, and Uses. By JOHN SMITH, A.L.S. London: Macmillan and Co.

WE have here a useful work, in a department of English scientific literature not over-crowded, and compiled by an author who has enjoyed exceptional opportunities for his task. Mr. Smith has for upwards of forty years been officially connected with the Royal Botanical Gardens at Kew, and was the Assistant to the late Sir W. Hooker in establishing and arranging the Kew Museum of Economic Botany. The plants are arranged alphabetically under their English names, in as far as such exist; the botanical names, according to Dr. Lindley's system, being used for the purposes of reference and identification. It is not too much to say that the work teems with valuable and interesting information, much of which is quite unknown to the reading public. It is sad to learn that many of the Australian species of *Acacia* are in danger of extirpation. They are cut down in quantity for the sake of their astringent bark, and no steps are taken for their propagation.

Concerning the Almond the author states that "none now come, as formerly, from the Valley of the Jordan." We have heard it lately maintained, however, that the name Jordan almonds is simply a corruption for Jardin,—*i.e.*, cultivated almonds,—and that they never were imported from the Valley of the Jordan.

The apple tree of the English version of the Old Testament is considered, on the authority of Canon Tristram, to be the apricot, which is exceedingly common in Palestine.

Hibiscus Rosa-sinensis possesses a singular property. Its red flowers when bruised turn black, and are then used for "colouring the eye-brows and blacking shoes." It is possible that this plant, which flourishes in Australia as well as in its native China, might be of service in dyeing.

A similar remark might be made concerning the red juice of the blood-berry (*Rivina humilis*), which is used in South Carolina as rouge, and the red juice of *Baloghia lucida* (the Norfolk Island "bloodwood").

Brier-root pipes, it appears, are made not from the root of the brier, but of the *bruyère*, a small tree of the heath family (*Erica arborea*), growing in Southern Europe and in Algeria.

We differ from the author in his statement that the Chinese green dye Lo-kao is extensively imported into this country and France. It was at one time met with in commerce, but is now superseded by the aniline greens.

We find Mr. White classes camwood and barwood as identical. The products met with under these names in the market show a decided difference when applied to tinctorial purposes, the colouring matter of camwood being the more soluble of the two.

Chica, sometimes used as a red dye, is, we learn, a monopoly in the hands of certain missionaries.

Concerning the cow-tree of Venezuela a curious incident is recorded. In 1830 a speculator introduced a thousand young trees into this country, and offered them for sale, quite forgetting that a tree from Venezuela could only flourish here in a hot-house! It further turned out that his cow-trees were not the genuine species described by Humboldt, but a species of *Achras*.

Concerning cudbear and orchil we cannot agree with Mr. White. Cudbear is now, and has for a long time been, obtained from the "orchella," the process of manufacture being different.

Saffron the author speaks of as a "valuable dye." This is no longer the case, as we have a perfect plethora of yellow dyes, many of them far superior to saffron in beauty and permanence.

This work will prove of no small value to all who take an interest in the vegetable kingdom, and who wish to know the original sources and the uses of our cultivated plants. It is least to be depended upon in the tinctorial department of technology.

The Field Naturalist and Scientific Student. No. 2, July, 1882. Manchester: A. Heywood and Son.

This new journal began well, and is going on better. In the present issue we notice some very interesting facts on the habits of animals. Mr. W. J. V. Vandenbergh gives a case of a "tame rabbit devouring earth-worms with evident relish." This, after all, is the less surprising if we reflect that other rodents—such as the rat, the mouse, and the squirrel—not only accept animal food, but attack and devour such creatures as they can master. Parrots, also, it appears in another paragraph, are liable to become carnivorous. Not to speak of the kea (*Nestor notabilis*) of New Zealand, but according to Dr. Buller "a whole fraternity of caged parrots took to cannibalism, killing and devouring each other, a *Platycercus semitorquatus* taking the initiative." There were four species, and, what is the more remarkable, the birds had lived in peace together for nearly two years. It thus appears that there is no such distinct boundary between carnivorous and frugivorous animals as closet naturalists, especially those of the Old School, would make out. There are, we may say, *carnivora de jure* and *carnivora de facto*, the former doubtless especially qualified for an animal diet, but the latter being easily led, by very trifling changes in their conditions of life, to turn predatory. It must also be remembered that many creatures which are carnivorous in their adult state become vegetarians when mature, whilst others—such as the robber-fly (*Erax apicalis*), so justly detested by bee-masters in some parts of America—reverse the process.

The Rev. M. G. Watkins raises the question "Do fishes feel pain?" It is said that "a large trout, taken in Loch Awe with an artificial minnow, had no fewer than five other minnow tackles, all bristling with hooks, hanging round its mouth." This is a subject by no means cleared up. Some close observers maintain that, as in fishes, the mouth is the principal organ of touch, we can scarcely conceive of it as insensible.

Some strange instances of mimetic resemblances and mimicry in animals are given by Mr. J. E. Peal, partly from the "Scientific Roll." It is said—"The tiger imitates the whistle of the large Sambur deer (to call it) so closely that only a trained ear can tell the difference. The leopard also imitates the smaller deer. The crocodile's eye and nose, floating on our muddy waters, exactly resemble the lumps of dirty foam so common here."

The "Field Naturalist" is doing a useful work, and has our good wishes.

*Le Monde Animal.** Par Madame STANISLAS MEUNIER. Paris : Hachette et Cie.

THIS work belongs to a series which is appearing under the title "Bibliothèque des Ecoles et des Familles." It consists of a series of sketches of some of the most remarkable animals, or of those which in the character of friends or of enemies intervene most closely in human interests. As a preliminary, we find a short section on classification, thoroughly Cuvierian, and therefore thoroughly out of date.

The animal kingdom is divided into four great groups, the mollusca being made to rank second, and all the remaining invertebrates, except the articulata, being summed up as zoophytes. The authoress, however, admits the necessity of adding a fifth class for the protozoa. For the apes in general, the name quadrumana is retained, little consideration being given to the anomaly of ascribing the name "hand" to an extremity provided with a true heelbone.

In her description of the elephant, the authoress makes the strange remark that the Hindoos and English still utilise these animals "in this barbarous manner," *i.e.*, in battle. Here she is mistaken : elephants are doubtless employed in our Eastern army in transporting artillery, but they are never caused to take part in action.

In describing the horse, she writes : "The Arab horse, the English horse, like the heavy Norman horse, the ass, the hippopotamus, and the swine belong to the order of ordinary pachyderms." We do not see the advantage of keeping up this arrangement. They might better have been grouped together as the odd-toed animals.

The description of domestic poultry is embellished with an engraving of a cock-fight. Though nothing is said in the text concerning the nationality of the scene, yet the costumes of the spectators too plainly proclaim them as Englishmen. Alas, we cannot accuse Madame Meunier of having slandered us ; ultra-humanitarian, or rather bestiarian England, which objects to the infliction of pain and death in the cause of science, is now experiencing a revival of cock-fighting, and very tenderly does she deal with the offenders !

The description of the carrier pigeon and its exploits leads the authoress not unnaturally to an account of certain painful episodes of the siege of Paris.

The chapter on venomous serpents is not free from marks of exaggeration. Thus it can scarcely be admitted that the existence of powerful antidotes against their venom is demonstrated.

The character of the toad is effectively vindicated from the superstitious accusations brought against him in France as well as in England. It is well to teach youth that this persecuted creature is not merely innocent but positively useful to man.

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* The Animal World.

The cockchaffer receives a considerable share of notice, as being in France much more numerous, and consequently more destructive than in our colder climate. As a means of turning them to account, it has been proposed in Germany to eat them! We fear our appetite and our courage would fail us in the experiment. A curious instance of their tenacity of life is given on the authority of Pouchet. A number of them having been submerged in water for forty-eight hours, and having to some extent entered into decomposition, if we may judge from the offensive smell and the discolouration of the water, revived on being taken out and exposed to a temperature of 77° F., and the next day four-fifths of them flew away.

The modern scourge of France, the phylloxera, is described at length. The authoress appears to have but little faith in the various schemes devised for combatting this frightful pest.

Notwithstanding a few questionable statements and the somewhat archaic classification which here and there comes to the surface, Madame Meunier's work is well suited to the readers for whom it is intended.

Studies of Venus Transits. An Investigation of the Circumstances of the Transits of Venus in 1874 and 1882, originally forming part of "The Universe and coming Transits." By Richard A. Proctor. London: Longmans and Co.

Transits of Venus, as the general public has been to some extent aware since Captain James Cook's first voyage, are of great scientific importance, as furnishing astronomers with one of the chief means of ascertaining that capital point, the distance of our earth from the sun. Such opportunities are rare, and when they occur are, or should be, eagerly and intelligently utilised. The present generation is in this respect eminently favoured. A transit took place on December 8th, 1874, and on December 6th next another will occur, which will be carefully studied by parties of qualified observers sent out by different governments to the most favourable stations. After this year no other transit of Venus will occur until the year 2004, a date naturally beyond the personal concern of any person now living.

The treatise before us is a portion of a larger work entitled "The Universe and the coming Transit." Some parts of the subject-matter had previously appeared in the "Journal of Science," the "Spectator," and especially in the "Monthly Notices of the Astronomical Society."

Concerning the relative value of the two transits of 1874 and 1882, Mr. Proctor differs from certain of his brother-astronomers, including the Astronomer Royal, Sir G. Airey, in attaching greater value to the earlier of these two transits. In certain portions of his work, which have now a mere historical interest, he argues that the preparations made by England for observing the former transit are not so complete and satisfactory as the occasion demanded. He gives in one chapter certain corrections of the Astronomer Royal's statements, and shows that in recommending certain localities for observation "someone had blundered." The localities recommended as stations for the phenomenon of 1882 would have been exceedingly suitable for that of 1874.

Microscopical Section Cutting. A Practical Guide to the Preparation and Mounting of Sections for the Microscope. By SYLVESTER MARSH, Licentiate of the Royal College of Physicians of Edinburgh, &c. Second Edition, pp. 156. Seventeen Illustrations.

THE first edition of this work, published in 1878,* has been for some time out of print, and has enjoyed the honour—thanks to the absence of international copyright arrangements—of a piratical issue in America. The present edition has been much enlarged and many new processes added, keeping pace with the numerous discoveries during the past few years, and including the new freezing microtomes working with ether spray instead of ice. Where tissues only require to be cut occasionally, or ice is difficult to procure, these machines are invaluable.

Very full details are given as to the various modes of staining tissues, processes which have done so much to advance histological investigation. Many new formulæ appear in this edition, and minute instructions are given for carrying out the operations on tissues requiring special treatment.

Every worker with the microscope knows that very few objects are in a condition for examination just as they are, except in the case of very thin and very transparent bodies; the only means of learning anything about their internal structure must depend upon the power of cutting sections of a suitable thickness. In most cases this needs a certain amount of preparation, varying with nearly every substance, to render cutting practicable: many tissues, also, after sections are made, are apparently homogeneous, and need the application of various colouring reagents to differentiate their otherwise invisible structure. It is true that beautifully cut and stained sections of both animal and vegetable tissues are now to be purchased, but the student requires something more than these,—he must have the power of investigating for himself,—and in Dr. Marsh's little book he will find a trustworthy guide to one of the most difficult branches of histological manipulation.

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* Journal of Science, vol. i. (3rd series), 1879, p. 135.

Household Chemistry for the Non-Chemical. By ALFRED J. SHILTON, F.C.S., Lecturer at the Midland Institute, Birmingham, and at the Walsall Institute. London: F. V. White and Co.

WE have here a work which seeks to explain some of the chemical phenomena daily witnessed around us, and to extract from them certain useful lessons. Books of a similar tendency, as the author admits, have from time to time been written,—we need mention only "Liebig's Letters," and an equally well-known treatise, the "Chemistry of Daily Life," by the late Prof. Johnston. In Mr. Shilton's judgment such works, however, have been at fault in containing "a quantity of matter that is certainly not of a strictly chemical nature, and which, however interesting in itself, swells the book to a large size without adding to its usefulness." It might perhaps be contended, in comment upon this passage, that it is a somewhat exceptional case when "interesting matter" does not add something to the usefulness of a book. What is more important, it is a difficult task, in treating of such subjects as our author undertakes to discuss, to eliminate all matter which is not of a strictly chemical nature. Mechanical, physical, biological, geological, and meteorological considerations obtrude themselves. Thus much of the process of candle-making, as described on pp. 39 to 41, is purely mechanical. Again, the last chapter, on food and physiological chemistry, includes no little matter which is strictly biological. In fact, were we to go over the entire book and strike out every passage not exactly chemical, not merely would its bulk be considerably reduced, but the connection would often be destroyed. We have pleasure, however, in admitting that most, if not all, of the subjects introduced are accurately and clearly, sometimes happily, treated, and that not a few popular delusions are shown forth in their true light. With one passage we find ourselves unable to agree: the author, speaking of bleaching agents, says —"The most important of these are chlorine, chloride of lime, and sulphurous anhydride. They all act by their power of oxidation, converting the colouring-matter into constituents which are more or less colourless."

That old rags can be transformed into starch-sugar by the process described by the author is perfectly true, but we devoutly trust that this transformation is not carried on anywhere upon a manufacturing scale. Old rags may be, and often are, saturated with the infectious matter of various diseases, and it by no means follows that such matter would be completely destroyed by the process of transformation.

Among the errors which the author exposes is the popular faith in "egg-powders." These, he points out, have nothing in common with eggs, being merely baking-powders coloured with turmeric. They may consequently colour and lighten, but cannot enrich the cakes, &c., to which they are added. The "corn-flours," he reminds the public, are simply starch, and as such contribute nothing to the formation of blood. It is something curious that an enlightened British public turns up its respectable nose at Indian meal. But if anyone extracts from such meal all its more valuable constituents, the albumenoids, the saccharine, and the fatty matter, and offers the refuse, or starch, at a high price, the public aforesaid buys and eats.

Ozone is another popular delusion. We can fancy the horror and disgust of Paterfamilias when he reads that the odour which he so greedily inhales at the sea-side consists "principally of the effluvium from decomposing crabs and sea-weed." The facts are that the presence of ozone in the atmosphere is far from proven, and that its physiological action is by no means invariably salutary.

"Household Chemistry" may be pronounced useful reading for young and old.

The Student's Guide to Quantitative Analysis, intended as an Aid to the Study of Fresenius's System. By H. Carrington Bolton, Ph.D., Professor of Chemistry in Trinity College, Hartford. New York: Wiley and Sons. London: Trübner and Co.

This work contains instructions for the quantitative examination of a number of selected bodies ranging from barium chloride up to urine, raw sugar, and petroleum. It must be remembered, as accounting for what the author calls the fragmentary character of the instructions, that they were originally intended as lecture notes, intended more to remind the student of the main features of the methods to be followed than to give every routine detail of procedure. Under each head there are also references to special authorities.

Turning to the instructions given for the analysis of potable waters, we find that the author recommends determination of potassium, sodium, magnesium, calcium, chlorine, sulphuric and silicic acids, organic and volatile matter, total solids, hardness, and oxygen required for the oxidation of organic matter. We do not find any reference to the possible presence of phosphates, nitrates and nitrites, ammonia, and nitrogen in organic combination—omissions to be regretted, since these substances, if found, are the chief indications of animal pollution, and serve as a pabulum for any germs of microbia which may be incidentally introduced. Nor are there any hints as to the possible occurrence and determination, if needful, of certain heavy metals, such as lead and copper.

In the analysis of milk Dr. Bolton recommends the determination of water (adding washed and ignited quartz-sand for the desiccation-process), fatty matter, sugar, total solids, and proteine compounds, the last item being found as difference.

Under Petroleum we note a circumstance with which we have been often struck in American technological and chemical treatises,—the preference given to Baumé's hydrometer. We are not aware that this instrument possesses any special or peculiar advantage, whilst it is open to the serious objection that its degrees cannot be converted into direct specific gravity by a simple calculation.

A Treatise on the Theory of Determinants, with Graduated Sets of Exercises for Use in Colleges and Schools. By THOMAS MUIR, M.A., F.R.S.E. London: Macmillan and Co.

THE object of the author of this work has been to furnish a full exposition of the theory of Determinants in a form suitable for students. The book is divided into four chapters, the first of which is merely of an introductory nature. The second chapter, devoted to determinants in general, furnishes their definition and all their important properties. The third chapter treats of special forms of determinants, such as continuants, alternants, symmetric determinants, skew determinants and Pfaffians, compound determinants, &c.; whilst the fourth chapter gives the history and bibliography of the subject from the Leibnitz downwards. An Appendix gives the results of the Exercises.

Papers and Proceedings and Report of the Royal Society of Tasmania for 1880. Hobart Town: Mercury Office.

We find here not a few facts of interest placed on record. Thus there are given the times of leafing, flowering, and fruiting of a few plants, as observed in the Tasmanian Botanical Gardens, from January to September inclusive. Black mulberries ripen in January, and peaches in February. The leaves of the ash and the oak begin to fall at the end of March. *Pyrus Japonica* flowers in June, and the yellow crocus in July; the apricot, poplar, and elm flower about the end of August, and the horse-chestnut in September.

Mr. F. McCoy and Mr. C. Gould notice the existence of large animals, probably seals, in the upland lakes of Tasmania, and suggest that the mysterious "bunyip" of the Australian natives is merely a seal of the group having external ears.

A paper entitled "Introductory Notes to the Natural History of Tasmania," by the Rev. J. E. Tenison-Woods, F.L.S., &c., is mentioned as having been read, but unfortunately is not inserted.

Mr. F. M. Bailey contributes an elaborate paper on the "Lichens of Queensland," in which their tinctorial properties are not overlooked.

The Rev. J. E. Tenison-Woods read a paper on "Some Introduced Plants of Australia and Tasmania." It is curious to learn that the common sweet-brier has become a rampant and formidable weed; so have the cochineal cactus, and one, or perhaps two, of its kindred. The common European furze is very abundant in Tasmania, but is not found on the Australian mainland. The American butterfly *Danais erippus* occurs all over Australia, and has been seen far out at sea in immense flights. It will probably become almost cosmopolitan.

Annual Report of the Board of Regents of the Smithsonian Institution, showing the Operations, Expenditures, and Condition of the Institution for the year 1880. Washington: Government Printing-Office.

This volume, in addition to the usual formal matter, contains a very copious and elaborate synopsis of the scientific writings of Sir W. Herschel.

There is also what may be called a directory of astronomical observations. It was the wish of the Council of the Smithsonian

Institution to obtain particulars concerning the staff, the instruments employed, and the character of the observations made. For this purpose circulars were sent round to all known establishments in America, and to many abroad, but in not a few instances the replies are very imperfect.

There is an interesting account of an official visit by the officers of the Smithsonian Institution to the Luray Cavern, in Page County, Virginia, a cave in a compact bluish Silurian limestone, probably not more ancient than the Mammoth Cave and the Wyandotte. The opinion of the visitors is that there is no cave in the world more profusely decorated with stalactites and stalagmites than that at Luray. There are no pools or streams, and consequently no aquatic fauna. A few spiders, flies, and one myriapod have been found.

The report on the progress of anthropology is exceedingly valuable. The reporter remarks that comparative psychology " has its bitter controversial side. Between the atheistic materialists, the agnostic materialists, and the theistic dualists there still exists that personal prejudice which blinds the eyes of the observer and confounds right thinking."

The volume also contains reports on the progress of astronomy, geology, physics, chemistry, botany, and zoology.

CORRESPONDENCE.

₊ The Editor does not hold himself responsible for statements of facts or opinions expressed in Correspondence, or in Articles bearing the signature of their respective authors.

THE "IMPROVEMENTS" IN EPPING FOREST.

To the Editor of the Journal of Science.

Sir,—There is every reason to fear that the process of converting Epping Forest into a park, which you have so justly deprecated, is being quietly pushed on, and that it has already begun to tell upon the fauna of the district. On the 12th instant I went along with an entomological friend to the Forest, and, though the day was most propitious, we were struck with the total absence of not a few kinds of butterflies which used to frequent the lower, or Chingford, end. I cannot help suspecting that the disappearance of the woodland pools, which have been drained to form the artificial lake, has something to do with the matter. I do not, for my part, see the necessity for this lake, especially as the River Lea offers full facilities for boating, bathing, and drowning. I found, also, that several old gravel-pits at the Epping end of the Forest, which I have known as the special resort of various insects, have been filled up and made level with the surrounding ground. If this process is to continue, the sooner naturalists know that the Forest is no place for them the better.—I am, &c.,

E. C.

THE EFFECTS OF BLUE GLASS.

To the Editor of the Journal of Science.

Sir,—Happening to take a rather prolonged look-out through a blue glass window which commands a view of sundry suburban gardens, I found the colour of the objects changed in a manner I should not have expected. Whilst the walls and roofs of houses, garden-paths, and some trees appeared of a bluish grey, the lawns, the vines, ivy, jasmine, and Virginia creeper trained to the walls, and a large patch of lettuces n a kitchen-garden appeared of a reddish bronze colour, and certain yellow doors (the conventional "oak-graining") became of a dull red. I do not know with what material the glass was coloured.—I am, &c.,

H. P. F.

"FAITH."

To the Editor of the Journal of Science.

SIR,—In the notice of this work in your August number (p. 489), your reviewer seems to have overlooked a mistake into which the author has fallen. Mr. Griffith writes (p. 163)—"Theorists had long contended that, to account for certain excentric phenomena with which they were familiar, there must be somewhere in Nature an unknown residual element which ever and again baffled their nicest calculations. They even ventured to describe minutely, *à priori*, more than one of its distinguishing properties, notwithstanding that the most careful observation had never been able to detect a trace of its positive existence. Happily by this time, thanks to the genius and perseverance of L. de Boisbaudran, the disturber has been caught *flagrante delicto*, in the precise shape and dress fore depicted, and is now recognised all over Science-dom as the new metal *Gallium*." Surely this is not a correct account of the discovery of the metal in question. Its existence was predicted by Professor Mendelejeff, not on account of any "excentric phenomena," but because, having tabulated the known elements, he found a certain gap, which, if filled at all, must be occupied by a body having properties intermediate between those of its nearest neighbours.—I am, &c.,

GORDIUS.

A REPLY.

IN reply to a querist we beg to say that the "Journal of Science" is not in any way an organ of medical opinion. It frequently happens, however, that the interests of Science, and especially of Biological Science, coincide with those of the medical profession, and in all such cases it is our duty not to keep silence.

NOTES.

Note on the Action of Salts of Alumina on White Sweet Peas. By A. Anthony Nesbit, F.C.S.—During the prosecution of the experiments on flowers (some notes on which were published in the July issue of the "Journal of Science") the following curious results have been obtained:—The stalks of some white sweet peas having been placed in a 10 per cent solution of potash alum, the petals after some hours turned a delicate pale yellow, and began to fade; the flowers were then taken out of the solution and pressed, and as they dried the yellow colour deepened. Ten per cent solutions of chloride, acetate, and sulphate of alumina were next tried, and in each case the yellow colour was developed in the petals of the peas, it being, however, strongest in the cases of the solutions of potash alum and the chloride of aluminium. White double primulas and white double stocks were then placed in 10 per cent solutions of the two first-mentioned salts; but while in the case of the primula the yellow colour was developed, in the case of the stock it was not. On a little further investigation it was found that if the petals of the white pea, or the white double primula, were mashed and moistened with a solution of any of the above-named salts of alumina, a bright pale yellow colour was at once produced. Stocks treated in the same manner turned a greenish yellow, although their flower had not altered in colour when placed in the solutions as described above. A number of sweet peas were then crushed, and their juice expressed, warmed, and filtered, when it became clear and nearly colourless. Strong solution of potash alum was then added, and the liquid became yellow. On the addition of ammonia the hydrate of alumina was precipitated, carrying down with it the whole of the colouring matter.

A report has been circulated that Sir David Lionel Salomons is the first inventor of the automatic electric system of railway-signalling. We beg to point out that he was in this matter anticipated by Mr. W. T. Whiteman, whose patent (No. 270, A.D. 1874) is dated January 22nd, whilst that of Sir D. L. Salomons is dated October 13th, or eight months later.

At the meeting of the Entomological Society, August 2nd, Mr. Pryer communicated a very important memoir on the butterflies of Japan with reference to seasonal, or rather temperature, varieties. Many species have two or three broods yearly, the specimens appearing in August being much darker and larger—sometimes double the size—than the March brood. At the same time, in cold and elevated localities in the mountains, the small, light-coloured, spring forms appear throughout the summer.

In the discussion which followed Mr. Meldola pointed out that many species which are monomorphous in the north of Europe show an increasing tendency to vary as the summers are longer and hotter.

At the same meeting there was read an elaborate account of the Coleoptera of Ceylon, by Mr. Lewis. The island has three distinct faunæ, depending on altitude and on the presence or absence of jungle. The Coleoptera, even the Cicindelidæ and Carabidæ, haunt trees and plants, and, like almost all the local insects, have undergone corresponding modifications. Very few beetles are found under stones, the protection of fragments of bark or moss being sufficient. There appear to be no *Necrophaga*, all animal refuse being consumed by the ants. Lucanidæ are scarce, the indigenous timber being too hard and dry to support such large insects. Concerning Buprestidæ and Longicornes nothing was stated. Dung-beetles are generally absent. Nor are there any peculiar endemic forms. Many of the smaller *Geodephaga* have unmistakable European affinities. Mr. Pascoe, in comment, suggested that Ceylon might be a region where the Palæarctic and Indo-Malayan faunæ meet, but in our present ignorance of the Micro-Coleoptera of India this is mere matter of conjecture.

M. R. Zeiller (" Comptes Rendus ") has made an examination of the fossil carboniferous flora of Tonquin. The species found resolve themselves into two groups ; the one consisting of forms which have been long ago met with in Europe, whilst the other comprises specific types peculiar to India, Australia, and South Africa. It appears that in the carboniferous epoch there must have been two great and very distinct botanical regions, and the south of Asia marks their region of union.

It is said of two eminent official scientists in England that the one fancies himself a physician and the other a metaphysician.

According to Messrs. Liveing and Dewar (" Proceedings of the Royal Society," xxxiii., No. 219, p. 428) the spectra of metals become seriously modified when their vapours are mixed together. New lines or bands may appear, whilst others disappear. Hence the authors are of opinion that much remains to be done before it can be maintained that any of the solar lines are due to a non-terrestrial element.

Herr E. Albert (" Annalen der Physik ") calls attention to the changes in the tone of coloured solutions produced by a decrease in the intensity of light. Blue-violet in diminishing light appears violet, greenish blue becomes blue, greenish yellow turns green, pure greens remain unaffected.

According to M. Larbalétrier *Cecidomyia tritici*, a Dipterous insect belonging to the Nemoceridæ, destroyed, in 1855, 48 per cent of the wheat crop in several departments of the east of France, whilst in 1846 it destroyed more than two million hectolitres of wheat in Belgium, thus occasioning a loss of 40 million francs.

M. A. Vollant (" Cosmos les Mondes ") produces the effects of grafting by a simple transfusion of the sap of the desired variety of fruit tree into a suitable stock. He gives his process the very ill-chosen name of " vaccination of plants."

According to the same journal the wines of the Gironde hold in solution a mean quantity of 63 milligrammes of iron per litre, a proportion surpassing that found in most ferruginous waters.

M. Ch. Musset (" Comptes Rendus "), after four years' observation at Grenoble, fully confirms the views of Darwin on the part played by insects in the fecundation of flowers. He testifies, in opposition to M. E. Heckel, that all orders of insects are represented up to 2300 metres above the sea-level ; that at greater heights the Lepidoptera, Diptera, and certain Hymenoptera are more numerous than the other orders ; that the number of genera, species, and individuals of nectarophilous insects is proportional to that of flowers, and is sometimes incalculable ; the hours of the opening and sleep of nyctitropic flowers (much more numerous than is commonly imagined) are synchronous with those of insects. Flowers and insects never fail each other, and hence M. Heckel's objection to cross-fertilisation, based on the alleged absence or rarity of insects on the flowering mountain-tops, must fall to the ground.

M. Ch. Musset has observed that dew is one of the predominating causes of the temporary disappearance of insects. (This explains the ill success which attends " sugaring " for moths on moonlight nights).

Mr. Norman N. Mason (" American Naturalist ") confirms the statements concerning the carnivorous character of the honey-bee (*Apis mellifica*). Dr. Fritz Müller has noticed several Brazilian honey-bees (*Mellipona varians*, *M. ceyrepie*, *M. gurupu*, and *Trigona pinguicosa*) licking the juice of fresh meat.

P. S. Legouis (" Comptes Rendus ") maintains that the *Cyclostoma*, &c., have a distinct pancreatic apparatus like that of the *Teleostei*.

The Abbé Giotti Ulivi (" American Naturalist "), after prolonged observations on hive-bees, maintains that queens are usually fertilised inside the hive ; that they are fertilised several times ; that the drones are not mutilated in the act of copulation ; that every egg that hatches into a male or female has been previously fecundated. There is no such thing as a fertile worker, and, in fine, parthenogenesis in bees is a myth.

According to the same journal two beetles (*Doryphora juncta* and *Cassida texana*) have recently changed their habits, and become parasitic on the egg-plant.

Another of our eminent scientific men, and a contributor to this Journal, came to an untimely end on the 14th instant. Prof. W. Stanley Jevons was drowned whilst bathing near Bexhill, on the Sussex coast.

"Festina lente" gives, in the "Geological Magazine," a refutation of Prof. Ball's speculations on the results of the moon's action of the earth, substantially identical with that which he communicated to the "Journal of Science" in March last.

Herr Dueberg suggests that the moon may be habitable on the side invisible to us, the water and the atmosphere being withdrawn thither by the effects of gravitation.

Dr. Beard's interpretation of thought-reading as merely muscle-reading is placed in peril by Mr. Bishop's recent experiments. The latter gentleman, it is said, can now find a hidden object *without* any contact with the person who has concealed it. We may, however, fairly doubt whether this fact brings the great question between animism and "materialism" any nearer to a solution.

A truly venomous lizard (*Heloderma horridum*), a native of Mexico, has been received at the Zoological Gardens. All its teeth, above and below, are, like the two fangs of death-snakes, furnished with grooves, and are in connection with poison-glands. A frog and a guinea-pig bitten by the animal died in one and three minutes respectively. The possibility of a venomous saurian has hitherto been denied on the very feeble *à priori* ground that no case of the kind had hitherto come under the notice of men of Science. It may be asked whether the learned world is not sometimes too hasty in rejecting common traditions without examination.

According to M. Van der Berghe (Soc. de Med. de Gand.) wheat contains 9·24 parts of metallic copper per million, and oats 10·8 parts.

According to M. Dareste ("Comptes Rendus") monstrosities may be produced, in birds, by simply prolonging the interval between the laying of the eggs and the commencement of incubation.

Prof. Plósz and L. von Udràn ("Zeitschrift für Physiol. Chemie") have discovered a new crystalline colouring-matter in two samples of morbid urine. The new pigment is of a bright violet-red colour, soluble in chloroform and ether, and distinguished from indigo which accompanies it by two distinct absorption bands, between D and E, though nearer to the former, and one between *b* and F, nearer the latter.

M. Le Bon (" Comptes Rendus ") shows that the emanations of putrid liquids are most dangerous to inhale after the odour of sulphuretted hydrogen has disappeared, and after their virulent action on subcutaneous injection has disappeared.

Dr. Greenley (" Louisville Medical News "), anent recent fasters, such as Dr. Tanner, remarks that the inferior animals, especially the pig, possess greater endurance in this respect than man. This power of endurance depends in a great measure on the fact that in the hog there is no (?) mental activity: hence the greater ability possessed by the imbecile to fast than by those whose mental faculties are in a normal condition.

The absurdity of the English law against vivisection is well illustrated by a remark of Sir James Paget. He says, " I may pay a rat-catcher to destroy all the rats in my house with any poison he pleases, but I may not myself, unless with a license from the Home Secretary, poison them with snake-poison."

According to Dr. Hewson (" Boston Journal of Chemistry ") the common European sparrow is capable of having and of communicating smallpox.

It is asserted (" New York Medical Journal ") that no authenticated case of rabies has ever occurred on the Pacific coast of America.

It is found that drunkenness is increasing in France just in proportion as wine is ceasing to be the national drink.

Prof. Spring, of Liege, finds that various bodies undergo important chemico-physical transformations at high pressures. Thus red phosphorus is converted into the black form at a pressure of 7000 atmospheres.

Dr. A. L. Adams, F.R.S. and F.G.S., who has been successively Professor of Natural History at Dublin and Cork, died since our last issue. He was well known for his " Wanderings of a Naturalist in India."

Prof. Ewart, the present occupant of the chair of Natural History at Edinburgh, does not find things working smoothly. We cannot, of course, presume to say where the fault lies, but it is reported that all the class assistants have resigned.

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THE

JOURNAL OF SCIENCE.

OCTOBER, 1882.

I. EXPERIMENTATION IN BIOLOGY.

By Oswald Dawson.

(Concluded from page 542.)

IN the Pangenesis chapter Mr. Darwin acknowledges indebtedness to experimentation by quoting the renowned experiments of Brown-Séquard, and again, or rather previously, in the chapter on Inheritance; also the section of a Nais by Lyonnet; the amputations of the limbs of salamanders by Spallanzani and Bonnet, Lessona and Philipeaux; the transplantation of the spur of a cock, and piece of periosteum,—of the tail of a pig into its back; and, finally, the experiments on transfusion by Mr. Francis Galton. In everyone of these directions have similar experiments been performed. M. Dupuy observed the effects of a section of the sympathetic transmitted to the second generation; bicephalous planarians can be produced by an anterior longitudinal section,—it is a remarkable fact that the anterior portion of a bisected earth-worm reproduces a tail before the posterior a head (Dr. Ch. Leteauneau, Biology, "Library of Contemporary Science"); the "individuality" of this creature has been studied too much; Paul Bert succeeded in engrafting the frozen tail of a rat in its back; experiments on the growth and inheritance of mutilated spleens; experiments on transfusion and cross-circulation are numerous, but experiments *ad infinitum* in these directions are not needed. The high value of the researches of M. Camille Dareste on the production of monstrosities is appreciated in the most genuine manner—*i.e.*, by utilising them—in the "Variation under Domestication," while they are pronounced "full of promise for the future" in the "Descent of Man."

The researches conducted so diligently of late, with a view to obtaining a precise knowledge of animal motion, may be mentioned as an example of biological experimentation. Those on the relation of muscle and nerve have become so popular as to be no longer confined to memoirs and textbooks, but receive untechnical expositions in volumes designed for general readers, the same remark applying to the registrations of bodily movements. Researches of the latter class have been pursued independently and with great diligence by M. Marey in France, and by Dr. Pettigrew in this country (see this "Journal," April and October, 1875), while the well-known philosopher, physician, and cleric, the Rev. Prof. Samuel Houghton, has made elaborate series of measurements, and studied muscular action, in himself and his friends; but M. Marey fixes contrivances on to the bodies of animals, as upon birds in flight, entailing some inconvenience, and no doubt also alarm, on the part of the creatures. The prosecution of these studies in this country would result in the prosecution of the experimenter too. The same enthusiastic investigator conducted a series of experiments at Naples with a view to the determination of the analogies, of the pausings, rapidity, &c., between electric and muscular shocks, thus following up the researches of Matteucci and others, who have demonstrated that, in a dying *Torpedo*, touching the electric lobe will give rise to a discharge intenser than that produced normally and voluntarily. At the instance of Du Bois Reymond a journey to Venezuela was undertaken for the purpose of investigating the *Gymnotus*. Those who have read the "Night Side of Nature" will not underrate the value of electrical experiments on *dead* animals, for Dr. Rosenthal ascertained that from one and a half to three hours after death reaction of muscles to electrical stimulation disappears, and testing an apparent death by this method he prevented burial ("Journal of Anatomy and Physiology," November, 1872).

Experiments have been made in animal mesmerism. We are thus drifted into the question of experimentation in Psychology. To cite an extremely important example from an account of this "Journal" of May, 1880:—A dog ran round a cage containing hares for two hours, at the end of which period his olfactory nerves and interior membranes of the nose were dissected out and ground up in glycerin: this preparation, swallowed by or injected into a mastiff, caused the dog to fear a cat, and the latter animal, after similar treatment, to be frightened to chase mice. The late Dr. Lauder Lindsay, in his "Mind in the Lower Animals in Health and Disease," and Dr. George J. Romanes, in his descriptive hand-book to a forthcoming treatise on Mental Evolution, quote Dr. Biddie's observation of a scorpion poisoning itself by means of its own sting.

Each of the last-mentioned cases independently suggests another, which leads us back to Physiology by as steady transition as when we left it. This account, too, is from this "Journal" (Dec., 1881), and is capable of condensation into four brief statements. The bite of enraged human beings may, like cobras, have fatal effects: in cobra-poison Dr. Gautier found an alkaloid possessing the properties of the ptomaines, which instantly convert potassium ferricyanide into potassium ferrocyanide, and which, when introduced into the system, occasion alarming symptoms, dilatation of the pupils, and death! the re-dissolved residue of evaporated saliva reduces the potassium ferricyanide, and, when injected under the skin of a bird, causes dilatation of the pupils, stupor, and death. Dr. Gautier finds the ptomaines are formed solely from the albumenoid portions of the dead body, though they occur in the normal excretions of man and of other animals, and in small quantities in our tissues.

And now, ye Sociologists, picture to yourselves the universal abolition of experimentation on the eve of the commencement of an exhaustive investigation of the genital system of the higher Mammalia. An impression prevails there is not that unanimity desirable respecting chastity. The exaggerations and habit-regulations of mendacious quacks and ill-informed clerics, of how little avail! appeals to Scripture when the very words which bind are rumoured capable of a biblical interpretation rendering them no guide; appeals to æstheticism, when it even seems questionable whether the dilution of sensuality vitiates or vivifies; appeals to a society that declines to recognise the policy of honesty essential to the attainment of its own equilibrium, compel each alike to insist upon a thorough investigation at the hands of Physiology.

And now we come to the Loving Cup—Experimental Neurology; hither repair the psychologist and the physiologist, the morphologist and the embryologist, the phrenologist and the metaphysician, the practitioner and the zoophilist. It is the subject of instruction to intelligent audiences for an evening's hour; its annals narrate scenes adapted to amuse an errand-boy; it is the bond retaining the veteran physiologist who has abandoned general work; it is the surest subject to rivet the attention of beginners; it is employed as the prop of Materialism, and wielded as the two-edged sword of dualistic theories; volition is reported to prostrate itself before its iron arm—the arm that is so warmly embraced by a certain transatlantic dissenting minister. The fact that polemical literature is saturated with accounts of and allusions to neurological experimentation may be no criterion of its value in moulding thought, and thus directing action, and if anyone assert such he may not fear contradiction, for it can only be assumed that the courage requisite can have been generated by profound study of the matter. On the other hand, to trace clearly the direct effect of each individual discovery, and theory, and contradiction on the conduct of men, must be the task of a specialist, but that the results are appreciated is patent to all, save those who are too busily engaged in composing epithets and insults as to find everything not immediately appertaining to some declared advance in medical knowledge "a little beyond them." Few conceivable events would be likely to have a more profound influence on European thought (as far, of course, as it is possible to anticipate from the survey of bygones) than the re-announcement and subsequent publication of Prof. Huxley's "Bodily Motion and Consciousness." If this volume offered no acknowledgment to neurological experimentation it would be somewhat strange.

How far menageries fall in our province here it is not easy to determine. The ideal of Bacon is in accordance with the spirit of this article (as so far written): he writes—"We make them greater and smaller than their kind is; . . . we make them differ in colour, shape, activity, many ways; . . . we have particular pools where we make trials upon fishes, as . . . . (also upon) beasts and birds" ("New Atlantis"). The results of the production and crossing of hybrids are invaluable (see Karl Semper, Chap. XI.). Occasional observation of feats of intelligence are instructive, but there is liable to be difficulty in judging how far imitation misleads ordinary observers who attribute an action to other forms of reasoning; thus when the Polar bear set in motion the water of its pool to secure a bun, it may have previously seen an umbrella used to return to the owner a piece of bun which had fallen outside the cage, to be aimed again, and thus we have a combination of imitation and originality. These creatures have cross-bred, killed other bears, but perhaps not acquired the art of suicide yet, unfortunately for themselves. It may be suggested that, if it is essential to keep these living pendulums in captivity, an obscure and inconspicuous site might well be chosen for their residence. The references to the tails of gorillas, chimpanzees, and ourang-outangs, that occasionally (together with other Simian details especially psychological) are reported, are traceable to menageries.

The leading museums require representatives of each species of bird's egg. The British youth who allows the fall of a coin to decide whether he shall make a collection of birds' eggs or postage-stamps, and then adjourns to the debate-room to recite the Kleinian replies, is a typical person.

The value of the observation of animals during life is now being recognised. Those who have access to the "Philosophical Transactions" should read the physiological paragraphs in the Kroonian lecture of Dr. Romanes and Prof. Cossar Ewart, on the "Locomotor System of the Echinodermata," and examine the elaborate accompanying plates. The individuality of the starfish arm was also investigated by these authors. The partiality of certain of these animals for light was ascertained, with other observations.

Cuttlefishes, snails, crayfishes, insects, &c., have been subjects of vivisection. This word is allowed a comprehensive meaning in this Article, including emotional pain on the one hand, and operation on "living" tissue, sentient or otherwise, "section" or no, on the other hand. It need scarcely be remarked that no exhaustive list of biological vivisections has been given here; numerous others could be cited in connection with Pangenesis and Hexicology. To prevent misconception it must be mentioned that the zoophilists have fully recognised the existence of physiological as distinct from medical experimentation, but, with a few instances as exceptions, have habitually conceived such physiology as is spoken of as the *Institutes of Medicine*; at the same time it is obvious that in Biology a physiology of *organs* supplements a physiology of *organisms*, and, for biological purposes, *vice versa* also.

Now we come to the point at issue: assume that the worth of future zoology depends to some extent, mainly or wholly, upon its experimental contributions, what step should be taken? Failure to secure opportunity for investigation in this country a specially English school might originate elsewhere, but those who watch the anti-vivisection movement know that the continental societies are becoming influential. Again, if the English bodies are successful will they dissolve in their triumph after effecting total abolition, or send aid abroad? But every investigator may not have facilities to go abroad whenever he wishes to carry on research, and it may not be convenient for every English constant worker to reside there permanently. Therefore, if it be not wrong to vivisect for biological purposes, investigators should strive to obtain licenses to do so at home. Is it wrong?

The answer to this question brings us to a conclusion,—a conclusion to an Article endeavouring to show that this "Journal," having previously conspicuously treated of biological experimentation, ought not to relinquish its mission at the moment zoophily is awakening; and, secondly, that experimentation has much service to render to zoology in the future, and that it has rendered some already; indeed it is only from a judicious sense of my own untitled obscurity and incomplete knowledge that I refrain from expressing the opinion that every further step in comparative anatomy is a waste of time and an unrighteous sacrifice of animal life; but we have not yet found an answer to *the* question for zoologists and zoophilists (for one is as much a "scientist" as the other, for ethics is a science), viz., Is the need for the acquisition of knowledge calculated to furnish men and women with answers to these questions—Is Evolution Darwinian, sub-Darwinian (conditions, use, &c.), or Mivartian (psychogenetic)? is consciousness to be considered "*apart*" and as eternal?—sufficiently imperative to render expedient, *i.e.*, moral, the study of any biology involving the slaughter, and the captivity of, or the experimentation upon, the lower animals?

I have considered this subject during the month past, and constantly while writing this Article: my conclusions may be likened to the space occurring between this Article and the previous or one following in this "Journal." The subject should be discussed by any who happen to be more capable, and reflected upon by all it may concern.

II. ON TECHNICAL EDUCATION.

By Robert Galloway, M.R.I.A.

(Continued from page 476.)

IN some of the previous articles we have shown how far behind other civilised countries England is at the present time in all that relates to a good school education suitable for boys intended either for trade, commerce, or manufactures; it remains for us to notice and discuss some of the efforts made by the State, through the Department of Science and Art, by the Universities of Cambridge and Oxford, and by the City and Guilds of London Institute, to improve the general and scientific education of the country, independent of, or in connection with, our Grammar and other Public Schools and Colleges which are supported either by private endowments or by Government grants. We shall also have to point out the absolute necessity there exists at the present time for the appointment of a special Minister of Education, charged solely with the over-seeing of educational institutions and of all matters relating to education.

The Department of Science and Art was established in connection with the Board of Trade in March, 1853, as a development of the Department of Practical Art; it was placed under the direction of the Committee of Council on Education in 1866. The grant it received in 1855 was £80,000; the grant this year amounts to £351,400, being a net increase of £18,369 on the past year's grant. The administration, in the form of salaries alone, will cost the country this year £8770; last year the grant was £8494.

The two Universities named established what are termed "Local Examinations" in 1858, for the purpose of supplying a common test of attainment for boys both in our public and private schools. In 1873 they enlarged the scheme by combining inspection with examination. The University of Cambridge commenced the organisation of a plan, in 1875, for promoting University teaching in populous towns, the object being to enable those who have left school, and are unable to proceed to a University, to continue their studies, by placing within their reach higher education of an accurate and methodical kind. The University of Oxford has lately arranged to carry on a similar scheme. I am unable to state the amount that is yearly expended by the two Universities on these different educational projects.

The City and Guilds of London Institute has been established for the advancement of Technical Education; the Institute has been in existence about four years, and its Committee expended on the department of education it has been created to promote, in two years ending the 20th February, 1880, £25,205 17*s.* 1*d.* They intend to expend on the building alone of a Technical University, at South Kensington, £50,000; the site has been given by the Commissioners of the Exhibition of 1851. The Committee of the Institute are also expending, on a University building at Finsbury, £50,000, and an additional sum of £5000 on laboratory extension at their Middle Class School in Cowper Street.

We referred in the article in the March number to the recent appointment of a Royal Commission to inquire into the methods adopted in Germany, France, and other continental countries, for imparting Technical instruction: since that appointment was made Mr. T. Armstrong and Mr. H. Bowler—the Director and Assistant-Director for Art of the Science and Art Department—have been instructed by the Lords of the Committee of Council on Education to visit the Art Schools of Germany and the Industrial Exhibition at Nuremberg, and to prepare a Report on German Art-teaching. And the Royal Commission on Technical Instruction have appointed Mr. H. M. Jenkins, the Secretary of the Royal Agricultural Society, to act as their Sub-Commissioner, to inquire and report on the present state of agricultural education and the courses of instruction given in agriculture at schools and colleges in Denmark, Holland, Belgium, France, and Germany, and they have also commissioned him to report on the present position of agricultural education in England. And not many years have gone by since our Consuls at the different continental countries were ordered by the Government of the day to draw up Reports, which were afterwards published in the form of Blue Books, on the systems of Technical instruction carried out in the different countries to which they were attached. In addition to all the information on the state of modern education in foreign countries which has been obtained and published at the expense of the nation, very valuable contributions on the same subject have been published by private individuals at their own cost.

Along with the vast mass of evidence that has been already collected by various English agencies on continental schools of every kind and continental methods of instruction, we have also the benefit of the opinions of eminent foreign educationists—as Dr. L. Wiesse, late Privy Councillor in the Ministry of Public Instruction in Prussia, on our educational institutions and systems. Dr. Wiesse has made a personal examination and inspection of our institutions on two different occasions; his last visit was in 1876, his previous one in 1856: his personal acquaintance with our educational systems and institutions, combined with his great practical experience of the educational systems and institutions in his own country, ought to render the opinions he has expressed with regard to our own, and which have been published in England, of very great value to us.

Whatever may result from the labours of these recent Commissions which have been appointed to inquire into the art and scientific teaching in continental countries, the necessity for these inquiries cannot be owing to a lack of knowledge, for we have abundance of information on these subjects. Too often it is to be feared Commissions are appointed and their Reports are published more for ornament than for use; they appear intended only to silence for a time a section of the public on subjects which at the moment are inconvenient for the Government or some Government department. There is a curious instance of this in reference to the Intermediate Education question in Ireland. Mr. Wyse, in his zealous endeavour, as a writer on the subject in "Hibernia" states, to bring the question to an issue moved for a Select Committee to inquire into the actual condition of the Endowed Schools in Ireland, with the object of carrying out necessary reform. The Committee was appointed in 1835, and after *three years'* investigation sent in a voluminous Report, recommending complete reform and re-organisation, which the collected evidence showed to be sorely needed. The Government received the Report with their characteristic apathy, and after the question had been shelved for forty years the Endowed Schools were subjected again to the *inquiry* of a Committee, starting on the same lines, collecting the same evidence in some instances, examining the same persons, and subsequently publishing the same stereotyped facts which astonished and amused our grandfathers. And the question has not even yet been settled.

It is continually stated by most of our scientific authorities, both in their public and private positions, that we are still far behind continental nations in scientific and technica education: this forms the *alpha* and *omega* of the speeches of our scientific men when they refer to education; it formed the note of lamentation in the opening address at the commencement of the winter session (1880) of the Society of Arts, delivered by Sir F. J. Bramwell, Bart., Chairman of the Council of the Society, and Vice-President of the City and Guilds of London Institute. The appointment of the Royal Commission to inquire into the subject is a tacit admission of the fact; and the admission is still further endorsed by the Lords of the Committee of Council on Education, for it is evident they think there requires such a thorough investigation into the Art-teaching in Germany, in order to improve the Art-teaching in this country, that it was not to be expected that the Director and Assistant-Director for Art, of the Science and Art Department, should themselves defray the expenses incurred by the inquiry, as they would naturally have done if they simply visited that country to add to their own knowledge of Art-teaching; and therefore the cost must be borne by the nation. Yet all who take an interest in education must or ought to be aware of the reasons which cause German education to be so superior to our own. We will notice in the next article some of the essential differences in the education of the two countries.

The non-success on our part does not arise from the State not supplying sufficient money for the purpose; for if we take a survey of the expenditure on the various educational institutions and schemes, the only conclusion that can be arrived at is that, if the expenditure of money was all that was required to obtain success, we ought to have the best general, scientific, professional, and technical education of any country. When we acquaint ourselves with the amount of money that is expended on education in the United Kingdom, we must all confess, I think, with Dr. Wiesse, that "the results are glaringly disproportionate to the *enormous sums spent* upon the education of young Englishmen; there is no department of human energy in which there is such a portentous display of power with such a *beggarly* amount of result." Again, the same high educational authority observes, with regard to our unorganised educational system, "If we except the elementary schools, public instruction in general does not in any way show a progress towards objects clearly recognised and defined. *An extraordinary amount of power, time, and money is still wasted from a want of plan and unity.*" Our expenditure is so excessive on occasions that we have sometimes to forego what more economical nations can undertake; the management of the English Department at the International Exhibitions, which has always been entrusted to the permanent officials of the Department of Science and Art, affords a very good illustration of this. Sir H. Tyler, M.P., in the House of Commons, on March 1st, 1881, asked the Secretary to the Treasury whether any, and if so what, arrangements had been made to afford facilities and meet the requirements of British exhibitors at the then forthcoming International Exhibition of electrical apparatus at Paris. The late Lord Frederick Cavendish, Secretary to the Treasury, said it was not intended to appoint a Commission for the purpose named. Past experience in connection with international exhibitions of a general character had shown that there was no kind of expenditure more difficult to keep within bounds. The expenditure incurred had varied between the limits of £28,000, spent in connection with the exhibition at Vienna, and £115,000, spent on that at Paris in 1867.

(To be continued.)

III. ANIMALS AND THEIR DIET.*

CERTAIN facts which have recently come before the public are drawing attention to the question "How did animals first become carnivorous?"—a subject which is the more interesting as it naturally blends with the so-called "Vegetarian" movement. In taking the matter into consideration we must first cast aside two words which enable men to mystify themselves and their fellows. I refer in the first place to the term "carnivorous." This word is sometimes applied to beings which feed on animal matter in general, but it is, perhaps, oftener restricted to such as prey upon the larger animals. Thus some persons would assert that a creature which devours merely worms, snails, insects, &c., is not carnivorous, and in fact zoological systematists have given the names Insectivora and Carnivora to two distinct mammalian orders. Others would maintain that an animal which feeds upon the eggs of birds is not on that account carnivorous, since eggs are not flesh. To get rid of all this confusion we must for once " do the thing our soul hates," and propose a new word. Let us call creatures which feed upon animal matter, of whatever kind, zoophagous. With the vegetable feeders there is a somewhat similar confusion. It is not strictly accurate, *e.g.*, to call a being which lives on fruits or seeds " herbivorous." Hence it is the safest to speak of all animals which feed upon vegetable matter as phytophagous—a term already in use.

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* How Animals became Carnivorous. By T. R. ALLINSON, L.R.C.P. (In "Field Naturalist" for August.)

This being then understood, we turn to the subject itself. If, as every one must admit, plants came into being upon our globe earlier than animals, then, as Mr. Allinson contends, the first forms of animal life must have nourished themselves upon vegetable matter. Hence the question when and how animals became zoophagous is perfectly legitimate.

But at the same time we must recognise that among vertebrate animals, and especially among Mammalia, the earliest forms seem to have been zoophagous. Among fishes, amphibians, and reptiles, even in the earlier geological epochs, the vegetable feeders are found in a minority. The earliest birds—such as *Archæopteryx*, *Hesperornis*, *Ichthyornis*, and *Apatornis*, which approach nearest to reptiles, and which were probably all armed with teeth—were plainly fitted for a predatory life. Among mammals the lowest and earliest forms are decidedly zoophagous. This is the case with the monotrematous genera *Echidna* and *Ornithorhynchus*, and also with not a few of the marsupials, both recent and fossil. The oldest of the true placental mammals are the Insectivora, including the hedgehog, the shrews, moles, &c. Yet few of these animals partake of vegetable food, save under the pressure of necessity. Nor do they by any means confine their depredations to insects. The hedgehog merits the favouring notice of man as being a destroyer of vipers, but at the same time it excites the wrath of the sporting world by its raids upon the eggs of the pheasant and partridge, and even upon the young birds and upon leverets, and is, for his size, as clearly a beast of prey as is the tiger.

It may even be permissible to ask whether among the mammals the purely phytophagous forms have not been developed from a zoophagous, or at least from an omnivorous, stock? The only large group which, according to our present knowledge, contains no zoophagous or omnivorous members, is the old order Ruminantia. Now this sub-order, which is first traced in the Eocene Tertiaries, is characterised by its complicated and highly specialised digestive organs, evidently modified from the normal mammalian type, so as to be adapted to a purely vegetable diet. This same structure, or at least one highly similar, is met with again among the sloths, the only phytophagous section of the Edentata.

The next consideration is that numerous animals which are zoophagous at one epoch of their life may be phytophagous at another, whether earlier or later. This change is not accidental or compulsatory, but ensues naturally and normally in every individual of the species in question. Thus all mammalian animals, whatever may be their future diet, begin life as zoophagous beings so long as they are nourished on their mother's milk. Indeed it is fully proved that, *e.g.*, the human infant is for some time incapable of digesting vegetable matter.

Among birds we meet with the same fact. Setting aside the many groups which are zoophagous throughout life, we find that, as a rule, the young of the seed- and fruit-eating species require an exclusively animal diet, consisting of insects, worms, &c. In other cases they are fed with half-digested food disgorged from the crop of their parents. There are few, if any, cases where a bird when just hatched is able to feed on crude vegetable matter.

Among insects many similar changes take place. The robber-flies of the genus *Erax*, which in their adult state destroy numbers of hive-bees, feed when larvæ upon vegetable matter. Not a few butterflies will sip the juices of dead animals, though in their caterpillar stage they are purely phytophagous. The larvæ of the hive-bee are fed upon honey and pollen, without any accompaniment of animal matter. But when mature they may be styled omnivorous, as, in addition to honey and juices of fruits, they are found to lick meat in butchers' shops, and even, according to Fritz Müller, to imbibe excrementitious liquids, as do also the butterflies.

Changes arising from a scarcity of food, or from caprice, are also on record. The two Carnivora which have become domesticated often partake of vegetable matter. The cat is even known to steal raisins and dried plums, and, according to Mr. Bates, in Brazil it goes into the woods to eat the fruit of the Tucuma palm. But amongst wild animals a change of diet when it occurs is almost invariably in the opposite direction, *i.e.*, from vegetable to animal matter. Under this head must figure the well-known case of the sheep-eating parrot of New Zealand, the outbreak of cannibalism in an aviary of parrots recorded by Dr. Buller, and the zoophagous tastes recently developed by baboons in South Africa, who, according to Mrs. Carey-Hobson,* sometimes kill and devour sheep. These instances show that the habits of animals are not so fixed as was formerly imagined. They have their preferences, and their digestive organs may be better adapted for one kind of food than for another. But with few exceptions they will not starve, and if what may be called their natural food is wanting, or is scarce, they take any substitute which presents itself. Curiously enough, when any species has thus adopted a new diet, it shows a disinclination to return to its former food.

We have next to consider that the majority of warm-blooded animals are omnivorous, in so far that they consume both animal and vegetable food.

Thus, beginning with the Primates, it is a great mistake to assert that the apes and monkeys are purely vegetarian in their diet. They never omit an opportunity of robbing a bird's nest, and they feed with avidity upon a great variety of insects from fleas upwards. The lemurs are, if anything, a shade more inclined to animal food than the true monkeys. Even amongst the Carnivora we find not a few which vary their diet more or less with vegetable matter. Thus the bears and their allies, with the exception of the so-called Polar bear, seem to prefer fruits, roots, honey, insects, and even grain before it is quite ripe and hardened. The Viverridæ also include some fruit-eating members, such as the civet-cat. There is no satisfactory evidence that any of the cats in a wild state will consume vegetable matter, but at least two groups of the Canidæ—the foxes and the jackals—are not averse to fruit.

Among the Rodents an omnivorous character is becoming more and more fully established. The squirrels, in addition to fruits, nuts, and grain, greedily devour eggs, nestling birds, and insects; the hamster, the so-called Norwegian rat (Waterton's Hanoverian, but which might be better styled the Russian), even the common mouse, and indeed all the true Muridæ, are omnivorous. We have little doubt but when the habits of the remaining Rodent groups are thoroughly known, it will be found that they all, in addition to their vegetable diet, prey upon insects, worms, and mollusks, if not upon more highly organised animals.

Among bats the majority appear to be purely insectivorous, but the so-called fruit-eating bats—the Pteropidæ or flying foxes—although provided with a complex stomach and voluminous intestines, feed also upon such small birds and mammals as they can capture.

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* Knowledge, March 17th, 1882.

The Proboscideans, of which the elephants of India and Africa are the sole surviving representatives, are purely phytophagous.

Of the three divisions of the great order of the Ungulata, two—the Solidungula and Ruminantia—are, as far as we know, strict vegetarians; but among the Pachydermata we find the swine, which may be regarded as the most typically omnivorous mammals, and the hippopotamus. All the species of swine are eager for animal food. When grubbing in the earth they snap up rats, mice, snakes, insects, &c., and when opportunity offers they have been known not merely to attack but to devour much larger animals. A horse left tied to a tree, in La Plata, has been known to be killed and eaten by a herd of peccaries. The feral swine of North America have contributed much to the extirpation of the rattlesnake, and the common English pig often contrives to catch and eat up domestic poultry which stray into his stye.

Among the birds we find a very similar state of things. The number of purely phytophagous species is relatively smaller, that of the exclusively zoophagous larger, and that of the forms recognised as omnivorous is increasing as our knowledge of their habits extends. Who, for instance, would, either from the morphology or from the general propensities of vultures, have predicted what has been observed by Mr. Bates, that these unclean birds devour eagerly the fruit of the pupunha or "peach-palm" (*Gulielmia speciosa*), and "come in quarrelsome flocks to the trees when it is ripe"? The common peacock is called a granivorous and fruit-eating bird; so it is, but at the same time a zealous and efficient destroyer of young death-snakes. Hence the way in which it is shot down by certain blundering sportsmen in India is nothing short of a public calamity. The pheasant is such an eager devourer of wireworms, grasshoppers, and the like, that his extirpation, as threatened by blundering "anti-sportsmen,"—if we may coin the term,—would be a very doubtful benefit to the farmer.

The Merulidæ—the thrush, blackbird, fieldfare, and their allies—occasionally evince predatory habits, especially in severe weather. The most purely phytophagous birds are the finches (many of which, however, feed their young upon insects) and the doves.

We now see that the zoophagous and phytophagous forms of animal life are not separated from each other by any sharply-marked characters, but are connected by a multitude of creatures intermediate in their organisation, and consequently adapted for a mixed diet. We see that animal food is regularly, and in considerable proportion, eaten by species not constructed on the typically zoophagous type as witnessed in the tiger or the polecat. Yet such species as we may infer from the very fact of their existence are not thereby injured.

We know that the great mass of vegetables, especially the leaves, stalks, and even the roots and the fleshy part of the fruits, are less nutritious than is ordinary animal matter. To this rule the seeds of a number of plants, such as the legumens and the various kinds of grain, form an exception, though even here it would appear that a part of the nitrogenous matter is not present in a state suitable for assimilation. In other words, it exists not entirely in an albumenoid but in an amidic state. Hence we must conclude that an animal which is to exist entirely upon a vegetable diet must have larger digestive organs, so as to operate upon the greatest quantity of matter at once. On the other hand, purely zoophagous species require, or at least can exist with, a smaller and simpler digestive apparatus. We may go a step further: of all nutriment the poorest—*i.e.*, that which contains the smallest quantity of blood-forming matter—consists of leaves and stalks. Accordingly the Ruminants, which feed upon leaves and stalks, have the largest and most complicated stomachs. In the Solidungula, of which the horse and the ass are typical specimens, the diet is the same as that of the Ruminants, but the stomach is simple, and digestion is in consequence far less perfectly performed, as an inspection of the respective excrements of the horse and the ox will readily show. May it not be that we have here the reason why the Solidungula as a sub-order are so far less rich in forms and less widely distributed? We come now to such animals as the swine. Here the divisions of the stomach occurring in the Ruminants are but faintly marked out, to suit a richer diet, composed largely of roots mixed with no inconsiderable proportion of animal matter. A step further we find the apes feeding on fruits and nuts, with the addition of eggs, larvæ, &c. Here the stomach is simple, and the whole digestive apparatus lighter in proportion to the entire body than that of the swine. Lastly, in the true Carnivora, where the diet is most concentrated, we find the digestive canal shortest, and the relative weight of the stomach and its appendages smallest.

Another point of difference between animal and vegetable matters is that the former require less preparation before they can be assimilated. Hence we find that the teeth of the dog or cat, besides their action in seizing and killing the prey, need merely to tear it into lumps of a convenient size for swallowing. When this is once done digestion is not difficult. Vegetable food, on the other hand, requires to be ground to a pulp, so that the saliva and the gastric and pancreatic secretions may act upon its smallest particles. Hence true molar teeth are required, destined not to cut, but to pulverise. We see an approach to this structure even in the bears. But for the poorest kinds of vegetable food this arrangement is not sufficient; the leaves and stalks eaten, consisting as they do largely of cellulose,—which man cannot digest at all,—have to go through that double preparation commonly known as chewing the cud.

We may now venture to assign a reason why it is easier for a phytophagous animal to turn zoophagous, than for a zoophagous creature to become phytophagous. A lion, or even an ape or a man, could not take into his stomach so much grass as would afford him sufficient nourishment. Not having the teeth of the ox or the sheep, and not being able to ruminate, he would fail to digest the grass in any degree even approaching to perfection, and he would soon perish from hunger, as not a few men have done who in times of famine have tried to support themselves upon grass and leaves.

But an ape, a rat, or a swine experiences no difficulty in digesting animal food.

Man approaches at least as near—probably nearer—to the pure zoophagous type as do the rodents and the swine. He has three kinds of teeth completely covered with enamel; his digestive apparatus weighs less in proportion to his entire body than does that of the swine, thus pointing to a more concentrated diet. Hence we should be inclined to consider that man is at least as naturally and originally omnivorous as the Rodents or the Suidæ. It has been contended that his "carnivorous practices have not yet changed his nature." Why should they more than has been the case in other omnivorous forms? If sharp nails, projecting canines, and a rough tongue would have given man any advantage in the struggle for existence, doubtless they would have been evolved. But these points do not in the least tell upon his power to assimilate animal matter.

His intestine, though of greater relative weight than that of the pure zoophagous species, is evidently required for his present mixed diet, and hence it persists.

IV. THE FOUR FORCES IN NATURE.

By George Whewell, F.I.C., F.C.S.

In a previous article* we ventured to enunciate a theory to explain the fact that the same piece of carbon (or any other element) in different states of combination had in one case the power of motion, and was what is called living matter, and in the other case had not the power of motion, and was what is called dead.

In Nature we recognised four forces, which we ventured to call atomic viva, organic viva, animal viva, and mensic viva (mind).

The same piece of carbon, in one condition having no power of motion, as when forming a portion of the root or stem of a plant, possesses atomic and organic viva. When it forms a portion of a nerve it possesses atomic, organic, and animal viva; and when it forms a portion of the brain, and causes man to think and act, it possesses all the four forces,—atomic, organic, animal, and mensic (mind) viva.

We assume that the elements contain these four forces in a state of activity or otherwise, according to circumstances. When the element belongs to the mineral kingdom it possesses only atomic viva, the other three forces being latent. When it belongs to the animal kingdom the other three are either active or latent, according to circumstances,—that is, according to the position they occupy in the body of a living animal or plant.

Take the life-history of our theoretical molecule of carbon. Suppose that a molecule of carbonic acid gas floats about in the atmosphere, and is driven hither and thither at the caprice of every wind that blows. In this condition atomic viva is alone active, the other three being latent. In its passage over the earth it strikes against the leaves of an edible plant; the sun is shining, and the molecule of carbonic acid gas is absorbed by one of the leaves of the plant; the carbon is retained, and the oxygen is given off again. The carbon becomes a portion of the substance of the plant. It has changed its condition from being a portion of a poisonous gas to be nutriment for man or animals. From being a portion of dead matter it becomes a portion of living matter. The gardener takes the plant, cooks and eats it; by-and-bye it is converted into blood, and is then in a condition to have its latent forces developed. It can become a portion of a muscle, and possess atomic, organic, and animal viva, and be a portion of a living body. It can become a portion of the brain, and produce thoughts—violent, demoniac, or sublime—at its own caprice. In this condition it possesses all the four forces in a state of activity. When it has produced these effects it again becomes carbonic acid gas, and finds its way into the outer world to be tossed hither and thither at the mercy of the winds.

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* Journal of Science, October, 1880, p. 639.

This same molecule of carbonic acid gas may go through this endless change from century to century.

New forces must of necessity develop, and become latent, in the molecule in passing and re-passing through this endless variety of changes.

V. FRENCH REACTIONISM IN SCIENCE.

IT might not unnaturally be supposed that in nations, as well as in individuals, the leading traits of character would be equally manifested in all departments of activity. We might, *à priori*, expect that persons bold and energetic in outward matters would display the same features in the realms of thought. This is not so. Dr. Beard has shown, in a work touched upon in our issue for last month, that two nations, physically and morally courageous, are intellectually timid. A similar, and perhaps even more striking, case of national inconsistency requires our present notice.

All authorities, from Julius Cæsar downwards to our own days, agree that in their private lives, as well as in public affairs, the French can by no means be charged with a blind and obstinate adherence to existing institutions: on the contrary, a fondness for novelty merely as such, a love of change, and a hope that such change will prove a remedy for inconveniences and evils in general, are generally considered to be with them ruling and deeply-rooted principles.

Hence it is a matter worthy of inquiry if we find this fickle and volatile people, commonly so called, resisting changes which their graver and more sedate neighbours across the Rhine and the Channel have seen fit to accept.

This exceptional adherence to the past is shown by the French in Science, and it has been recognisable from time to time for about two centuries. It was first distinctly manifested in the opposition shown to Harvey's discovery of the circulation of the blood. The announcement of this fact —although, as the anti-vivisectionists tell us, it was no novelty—was obstinately rejected by Riolan, probably at that time the most learned and influential physician in France, and by not a few of his colleagues and countrymen.

A far clearer and more striking case is the reception accorded to the Newtonian reforms in astronomy and physics. Bernouilli and d'Alembert repudiated the theory of universal gravitation.

In short, France may be said to have remained at heart Cartesian almost to the end of the last century, the new system—as Mr. J. B. Stallo well expresses it—finding adherents " slowly and reluctantly."

Turning to another science, it is well known that the greatest change in modern physics has been the rejection of the theory which regarded heat, light, electricity, and magnetism as so many kinds of imponderable matter, and the acceptance in the stead of the mechanical doctrine which views these great natural agencies as modes of motion. Now we do not mean to deny that the modern doctrine is accepted and taught in French seats of learning. But for all this the ghosts of the " imponderables " still haunt French lecture-halls and works on popular science. " Caloric " especially seems hard to exorcise.

Perhaps it may be suspected that the opposition to the above-mentioned innovations is the outcome of a mistaken patriotism.* Harvey was of course an Englishman; so also Newton, and the latter, in addition, was overthrowing the work of the great Frenchman Des Cartes. The reformers in physics, also,—Clausius, Meyer, Joule, Helmholtz, Rumford, and Davy,—were none of them natives of France. To set aside this supposition we must refer to cases of change in which French genius has been largely concerned, and which have yet experienced in France an unkindly reception.

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* *Pure* Science is cosmopolitan. But we doubt whether an inventor in technical chemistry, and a nominally scientific traveller whose real functions are those of a military spy, should be honoured by the nation which they are seeking to injure.

We take first the inauguration of the so-called "new chemistry," involving the rejection of dualism, the recognition of substitution, and of the doctrine of atomicity. These views, with the corresponding changes in notation and nomenclature, are all but universally recognised in England, Germany, Italy, Russia, and America. An elementary treatise which should ignore or reject the more recent views would in England be useless, since a knowledge of these views is obligatory upon all examinees in chemical subjects. A paper read before the Chemical Society, in which the notation and the theoretical views found, *e.g.*, in the Cavendish Society's edition of Gmelin's great work, were employed, would be received with amazement almost as blank as if the reader were to revert to the language and ideas of the pre-Lavoisierian epoch, and to account for phenomena by the presence or absence of phlogiston. In Germany it is expressly demanded that the language and the symbols (if any) employed in the specification of a chemical patent must be in accordance with the present state of knowledge. In America the nomenclature of the "new chemistry" has actually found its way into the workshop and the market.

But in France the state of affairs is altogether different. In treatises written by eminent chemists, and in memoirs written before the Academy of Sciences and duly printed in the "Comptes Rendus," we may still find, *e.g.*, the symbol for water written HO.

Now it is certainly true that what is by some authors now spoken of as the "old chemistry," with its accompanying notation and terminology, was to a great extent established by Lavoisier and his friends, and was hence for a time even called "la chimie Française." But, on the other hand, the system now in the ascendant owes perhaps more to France than to any other country, as we shall admit if we duly estimate the labours of Dumas, Laurent, Gerhardt, Ampère, and others. So that the slow progress, and the very partial acceptance of the new chemistry in France cannot be in any marked manner traced to national jealousy.

We come now to a far wider and deeper change in Science than any of those we have just considered, the Newtonian movement not excepted. When Darwin resuscitated and established the doctrine of Organic Evolution he met with eager and powerful coadjutors and allies in almost every civilised country. The master-minds of Germany, Holland, Italy, Austria, flocked to the standard of Development, and soon furnished splendid contributions to the evidences of the new truth. In America Darwin experienced the same general welcome, save from Agassiz, *a Franco-Swiss, deeply imbued with French traditions.* France alone, among all nations of high culture, took up a hostile position. It is true that many French naturalists admitted the importance of studying Nature in the light of the new revelation ; but the leaders of French Science, the Scribes and Pharisees of the Academy, the Museum, and the University, would have none of it. The Academy of Sciences formally rejected Darwin, and it must not be forgotten that in the official eulogium delivered on occasion of his death before that august body, by M. de Quatrefages, this rejection was not recanted, deplored, apologised for as an indiscretion and an error, but upheld and justified as an act of dignified and judicial impartiality ! It may be here said that Evolutionism and its modern champion have been opposed and denounced in other countries no less than in France. True, but by whom ? Darwin's English, German, and American opponents were clergymen, lawyers, historians, poets, cultivated men of the world, without any special acquaintance with the natural sciences. The French hostility to Evolutionism centered in the learned institutions, and was presided over by biologists !

Here as little as in the case of the recent reform in chemistry can we trace the cause to national jealousy. Darwin and Wallace were of course Englishmen, but in the last age France had contributed nobly, by the hands of Buffon, and especially of Lamarck, to the foundation of the new natural history. It would have been open for the Academy of Sciences, with a little exaggeration, to have claimed Evolutionism as " la biologie Française," and to have pronounced Darwin merely a successor of Lamarck. Some French writers have adopted this view, but that the leaders of French science should prefer to reject Evolution altogether is a problem of some interest.

Some persons—including a writer in this Journal—suggest that the cause of the peculiar attitude taken by France in view of Evolutionism, and generally of great scientific reforms, may be ethnological. The Celt, they tell us, lives in the past as essentially as the Teuton does in the future.

The former broods over and tries to revive former conditions, real or imaginary, whilst the latter, "unhasting and unresting," makes preparation for days to come. On this supposition old theories should be upheld in France rather than in Germany, and in Ireland and Scotland more than in England. In this connection we are reminded that many of the most prominent anti-Darwinians in the United Kingdom are, judging from their very names, of Celtic origin. But in opposition to this ethnological hypothesis we must remember that the French, in matters other than scientific, are by no means apt to reject what is new simply on account of its novelty.

One theory then remains: France is averse to new discoveries because in her, more than in any other country, Science has assumed an official character, and is practically under the control of an oligarchy. Such bodies, whether national, municipal, ecclesiastical, or literary, have in all ages and in all countries been noted for an unreasoning conservatism—if we may venture here to use so ill-defined a term—and for jealousy of outsiders. The Academy of Sciences has most of these unpleasant features. The number of its members is absolutely fixed, and no merit can open the door to a candidate until there is a vacancy. The election of a member requires to be confirmed by the head of the State, be he emperor, king, or president. The Academy is the especial scientific adviser of the Government; it has the task of awarding a great number of prizes which have been given or bequeathed for merit in various branches of science, or for eminent discoveries and inventions. In other respects it possesses, directly or indirectly, a great amount of patronage. If a college professorship or a curatorship is vacant, the opinion of the Academy generally decides the appointment. If a scientific expedition is to be set forth, the selection of the explorers rests practically with the same body. It stands, too, alone. The other scientific societies of France are comparatively powerless and uninfluential, and never even attempt to question the doings of the Academy. Indeed to do so is in many quarters considered as exceedingly "bad form." It will be perceived that such powers as are conceded to this learned body are exceedingly liable to abuse. Unless its members are actuated purely by the love of truth they will scarcely be able to resist the temptation of using their influence for their own aggrandisement: hence an outsider—a young and unknown man, or a foreigner—has no small difficulty in securing a fair hearing. If he has made investigations which do not clash with the results obtained by any academician, and if he shows a due amount of deference, all may be well. But how is he to secure fair play if he has run counter to and refuted theories to which some academician stands committed? It may, indeed, happen that in some branch of science the illustrious body in question may include two rival luminaries. In that case the outsider, if he has been overlooked by M. le Professeur A, will find in M. le Professeur B a most zealous champion, and by thus playing off the Montagues and the Capulets against each other he may obtain recognition. But it may happen that in some one department there is an autocrat, a man less noted for the brilliance of his discoveries than for the perseverance and energy with which he has fought for power and influence. How will the outsider fare in the French scientific world if he has overturned the theories which this man has all his life striven to conserve? This was precisely the fate of Darwin and of Evolutionism before the judgment-seat of French official science. They must be ostracised by those who, as far as biology is concerned, have striven, and successfully striven, to cramp up the intellect of France in the straightest doctrines of Cuvierism, and to keep French youth from sharing in the onward intellectual movement of the rest of Europe and of America. That their brother immortals raised no objection need not surprise us; they merely acted like the ancient Roman triumvirs in settling a proscription-list:—"Allow me to condemn Darwin, and I will do as much on occasion to oblige you!" We understand, now, surely, the reactionary spirit which has been so often manifested by French science. It is but the natural working of centralised officialism.

Germany presents a totally different picture. There no one learned society stands in especial connection with the State, and is enabled to dominate all others. Every university is an independent centre of intellectual action. There is that fulness, that variety, which we always recognise in vigorous life.

In England, Science, if not subsidised by Government, has been free from control, and herein has been its salvation.

Will it retain this freedom, or will it fall into bondage to a centralising bureaucracy? The danger with us is not, we must remember, from the Royal Society, but from a totally different body, which we fear aims at powers wider far than those possessed by the French Academy.

VI. FASHIONS AND EVOLUTION.

By D. Y. Cliff.

BY "Evolution" I intend in it the sense of "alteration," one way or another. All of us are often struck with the partially vain efforts of old women "to look young," and the wild despair that refuses to be called "old," nay, nor yet "middle-aged," until they are too hideous even to behold themselves. Our *great* Elizabeth shrunk horrified from her glass many years before she died, and indignantly ordered the too faithful coin-die to be destroyed. We feel assured that Eve herself must have wept over her departing charms.

All this perseverance, mental and physical, for countless ages must have had a very definite effect on her progeny. May it not be seen in the very brutes? If these fits, it be said, do only come on in later life, it cannot be denied that they are in full activity in the mother.* It is a very familiar fact what a marked effect the thoughts, &c., particularly the terrors, of a parent have on the child unborn.

Then, perhaps, it is more than a vague theory to argue that this vain tendency in woman (and man for that matter) is really "a great and lasting benefit" to humanity: with Bentham we can say it "enables a greater number to live happier," &c.—in a word, improves the "human face divine." This being a "fault" of man's too (howbeit in a smaller degree) the whole human race is rendered handsomer and more agreeable to look upon for a longer period of life: many other effects necessarily follow therefrom. One would say that the foot of a Chinese lady, naturally grown, would be smaller than ordinary where it was a family practice. I am inclined to think, from an inspection of engravings† of old Greek statuary, that our modern "thin waist" (as now understood) amongst females is the result of fashion, and that from even so late in the world's history as the earliest civilisation in Greece, and maybe in Egypt. Nay, the tapering may be almost said to be outwards and downwards from under the arm-pits to the hips.* Was it only the idle fancy of the sculpturer, in direct variance with fact? Had the bevy of young ladies who formed Zeno's models of Venus all this "fault"? In her loose elegant garb the girl of ancient Hellas could expand and develope naturally; we do not suppose the "virgin cord" would be drawn very tight. Look at the figure of "Venus, from the baths of Claudius"† —the uplifted arm gives the taper there. Nevertheless, though they seem straight, or even outwardly tapered, it must be admitted that the tendency to a thin waist is there, though very remote from the modern "eighteen inches round, my dear"! Mr. Park Harrison, M.A., in a recent paper, would seem to throw considerable doubt on the veracity of these figures as representing the Greek proper of their day.‡ If we will now consult engravings of modern art§ I think we shall be at once struck with the (unconscience?) production in accordance with modern taste: the waist is made decidedly thinner.

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* Some hold that the children of elderly or old parents are handsomer than those of younger ones. Is there even a partial truth in this? (Of course other items step in as well.)

† My source is "The Pictorial Gallery of Arts," vol. ii., 1847.

Thin waists are not uncommonly *natural* now-a-days, and may be the result of "fashion." It is well known how the cultivation, amongst savage tribes, of monstrosities—*e.g.*, thick and protruding lips, large ear-lappets, &c.—tends to "improve" them, although they would probably disappear speedily if neglected, "unless the variety became the species" through a majority of numbers: the permanency of the Hapsburg lip is notorious as well as creditable.

Again, according to the same statues, man always possessed a contracted waist, and possibly the distinction may have been exaggerated to give a more sensuous *livingness* to the stone "creations." There is an entire absence of the ugly breasts that disfigure the "savage breast" of a female (seen in Hindoo figures), nor is it imaginable that the ladies of Thebes or Athens ever wore "stays."

I cannot close these remarks without drawing attention to the fact how very *English* the busts of the most famous men of old look: observe them. Were they to rise from the dead and don the modern breeches they would pass unheeded even in our quietest villages. Imagine Julius Cæsar, Cicero, Aristotle, &c., with chimney-pots on their heads!

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* *Ibid.*, *e.g.*, fig. 816, p. 228.

† *Ibid.*, fig. 803, p. 225. See also Figures of Venus, 846, p. 233.

‡ *See* Report of the British Association, 1880, p. 625, &c.

§ *See*, *e.g.*, The Illustrated Catalogue of the Exhibition of 1851, published with the Art Journal, pp. 2, 48, 151, 225, 234, &c.

VII. THE PALÆONTOGRAPHICAL SOCIETY.

By W. Jerome Harrison, F.G.S.

AMONG the Scientific Societies of Great Britain the *Palæontographical* must be assigned the first position, if we consider the results obtained in proportion to the amount of money expended. This Society was established in 1847 "for the purpose of figuring and describing the whole of the British fossils." No entrance-fee has to be paid, and there is no form of election to be gone through, but "each person subscribing one guinea is considered a member of the Society, and is entitled to the volume issued for the year to which the subscription relates. The thirty-six volumes that have been published contain an amount of geological information which may be in some degree realised from the statement that they include more than 10,000 large quarto pages of letterpress, in which 5019 species of fossils, including representatives of almost every division of the animal and vegetable kingdoms, have been described.

But a description of a fossil in words only is, as a rule, insufficient to a thorough comprehension of its nature and appearance; accordingly these volumes are illustrated by 1467 large plates, on which are 26,260 figures, executed in a style which may fairly be described as unsurpassed, if not unequalled.

It might have been thought that such a great undertaking as this should have been a matter for the Government to carry out, its execution being entrusted say to the Geological Survey, conjointly perhaps with the British Museum. But that is not how we do things in England; and let us be thankful that it was not so, or we should have suffered from the long delays, poor printing, and high prices which have characterised the publication of the Memoirs and Maps of the Geological Survey.

The thirty-sixth volume of the Palæontographical Society, just published, opens with a list of the 494 members belonging to the Society, by whose annual subscription of one guinea the expenses of its publication are defrayed. The first impression of any reader must be that the volume is by far the cheapest scientific publication he ever took into his hands; for the paper and printing are of the best, the writers stand in the very foremost rank of science, and the plates are simply magnificent. The explanation lies in the fact, firstly, that no money is paid to the authors for their contributions, the work being entirely a labour of love on their part; and secondly, that the Society possesses in the Rev. Thos. Wiltshire a Secretary whose business qualifications are on a par with his high scientific acquirements.

The new volume opens with the final part of an account of the beautiful fossil ferns found in such profusion in the Eocene days of Bournemouth; next, Dr. Wright concludes his description of the 124 species of sea-urchins which occur in the chalk of Britain; the same palæontologist continues his account of the Ammonites of the Lias; Dr. Davidson gives another instalment of his grand work on the Brachiopod shells; and Mr. S. V. Wood adds a short supplement to his father's classical description of the shells which occur in the "crag" of Norfolk and Suffolk. A remarkable feature in this volume is the account given by the Rev. N. Glass, of Manchester, of the manner in which he has succeeded in working out, for Mr. Davidson, the internal "processes" and "spirals" which occur in the interior of Brachiopod shells. Thos. Davidson, Esq., LL.D., F.R.S., has been a great mainstay of the Palæontographical Society; he has devoted his life to the study of the Brachiopoda; he has drawn for the Society, with his own hand, on the stone, 8549 figures of these shells, besides writing 1785 accompanying pages of letterpress. Naturally his enthusiasm has communicated itself to others, for Dr. Davidson is ever ready to help the most humble student of geology. In the Rev. Norman Glass Mr. Davidson has found a coadjutor of unwearied patience and exquisite skill. In fossil shells we have, of course, only the hard parts of the animals preserved; now Brachiopod shells have internal "hard parts," in the shape of complicated spirals or projections, to which, during the life of the inhabitant of the shell, the soft parts were attached. These "spirals" still exist in the fossil shells, but, being completely enveloped by the hard, stony matter which fills the shell, their shape, and position were almost unknown until, in 1877, Mr. Glass discovered a means of laying them bare. He selects such shells as are filled with semi-transparent "spar," and by diligent scraping with the point of a penknife, aided by occasionally immersing the shell in dilute hydrochloric acid, he has made many most beautiful preparations, enabling Dr. Davidson to separate species that had previously been confounded on account of their external similarity, and even to establish several new genera.

Mr. George Maw, of Broseley, has rendered efficient aid by submitting about 20 tons of Silurian shale to the action of a potter's "blunging" or clay-levigating machine: when the fine clay was washed away Mr. Maw employed women to pick out the fossils from the *débris*, and obtained for Dr. Davidson, in this way, about 50,000 specimens of Brachipods! We recommend this plan to the notice of geologists in other parts of the country; a washing-tub and "dolly" would make a very fair substitute for the potter's machine.

In looking over the back volumes of the Society, the names of Prof. Owen, Mr. Searles V. Wood, Mr. J. W. Salter, Prof. Duncan, Dr. Lycett, and Dr. H. Woodward stand out prominently, while the list of articles "in preparation" includes the names of the best men of the day.

But when may we hope for the completion of this great work? Perfectly complete it can never be, for every year, as the rocks continue to be searched, new species turn up, which require to be figured and described; but when may we hope for the practical completion? The total number of known fossils from the British strata may be estimated at 15,000 species. If in its thirty-six volumes the Palæontographical Society has been able to give an account (as it has done) of 5000 species, it is clear that, at this rate of progress, we shall be half-way through the twentieth century before the entire work even draws near to an end. It is true that this is a work which cannot be *hurried*, but with an increased subscription list its completion might certainly be *accelerated*.

The stock of back volumes is but a limited one, and, although sets of them may now be had at a reduction, yet their value will be undoubtedly high in future years. Every local scientific society and every local library ought to possess a set, for to a working geologist these volumes are simply indispensable.

In the hope that many of our readers will use their influence in this direction, we give in conclusion the Secretary's address:—Rev. Prof. Wiltshire, M.A., F.G.S., 25 Granville Park, Lewisham, London, S.E.

VIII. SUNLIGHT.

WHEN we consider the countless ages that the sun has given out his daily light and heat, without our most delicate instruments being able to detect any loss in substance or energy, we are apt to conclude that there is something wanting in our theories to explain how such constancy is brought about.

The law of gravitation gave the key to what had been previously inexplicable in planetary motion. It showed us how mass was attracted by mass, and how world was influenced by world; but we seem to have altogether overlooked the force which must result from this universal attraction and this never-ending motion. Is it here that we are to seek for the force that builds up a sunbeam?

If we rub a glass rod with a piece of silk it becomes warm through friction, but independently of this its attractive properties are greatly increased, and it is found to emit light and heat when brought into contact with the earth. What has brought about this change? The answer is Motion. But motion alone would never have had these after effects unless there had been a prior mutual attraction between the two bodies. This imperceptible attraction was overcome by the motion, and the result was that the attraction was not only increased, but the surplus force appeared, in a spark, as light and heat.

If under peculiar circumstances one magnet is revolved in front of another, the same effects are observed, although in this case there is no contact between the two bodies. If we disturb the attraction which holds together the atoms of a chemical compound, whether it be in the solid, the liquid, or the gaseous state, we have this same emanation of light and heat. If, then, these great effects can be produced in our laboratories, what must result in our Solar System from the continual struggle between attraction and centrifugal force?

In our own system we find our glass rod replaced by a rolling world 882,000 miles in diameter, round which is continually circling a host of other worlds. Here there is no contact, therefore no friction to retard and disarrange the whole, but there is a mystic tie that binds them all together —there is, in fact, attraction. When this attraction is disturbed by motion the result must be as in our former experiments, light and heat; and the chances are greatly in favour of such light and heat originating in a huge electric discharge. But as it would be difficult fo account in this way for all the heat received at the earth's surface, it is probable that the original discharge is comparatively cool, and that it becomes heated only when it encounters a resisting medium such as the earth's atmosphere.

Supposing sunlight to consist of an electric discharge, it is probable that on striking the earth's surface it travels over the whole of the *illuminated* side in a series of curves radiating as it were from near the Equator towards the North and South Poles, where, when the earth becomes fully charged, the discharge makes its escape, and appears to us as an Aurora or some other familiar phenomenon. The supposed direction in which the terrestrial currents travel may be well seen by sprinkling a small quantity of fine iron-filings on a piece of cardboard held over a bar-magnet. The two points where the lines of force converge will represent the north and south magnetic poles, and a line drawn equidistant from and at right angles to these two points will represent the magnetic equator, and the lines diverging from the outside of the poles the return current.

At first sight it would appear that this comparison was fallacious, as it is obvious that if the curves joining the two converging points were insulated, and an electric current passed from the outside towards the centre, or *vice versâ*, the effect would be not to form two poles, but only one, situated on the equatorial line. But if matters were so arranged that the current travelled in different directions, from the equatorial towards the converging points, the effect would be changed, and we would have two poles, one of which would attract and the other repel the north pole of a magnet.

If these latter speculations be correct we might be able to find an explanation of the secular, annual, and diurnal variations of the compass, on the assumption that such variations were caused by a slight change in the direction of the current, owing to the revolution of the earth, and also to the presence of induced currents on the non-illuminated side.

As the object of this paper is to present the speculations contained therein in a general form it will be unnecessary at present to go into details, but rather to try to prove shortly that the action of motion on attraction results in sunlight; and the most direct proof that can be brought forward will be found in the appearance that a comet presents in its approach to and departure from the sun.

According to the more advanced theories regarding comets, they are thought to consist of solid matter, and rigorously to conform to the laws of gravitation, and strictly to follow out their orbits. When a comet is far away from the sun it appears very much like ordinary stellar matter; but as it gradually approaches the sun, and as its motion increases, it becomes more brightly illuminated, and sends out short streaks of light sunwards. Shortly these streaks are forcibly driven back as by some repellent force, and gather about the head of the comet in a bright halo. On a nearer approach this halo appears to be partly thrown off, and one or more tails formed on the side away from the sun. When the comet sweeps round the sun its tail wheels round along with it, always keeping away from the sun, and as it recedes its tail—which is now in front—gradually dwindles away, until it appears as ordinary stellar matter again.

As comets (at least those that we have most to do with at present) travel in infinitely long ellipses, and strike the plane of the ecliptic at a considerable angle, they may be considered, for all practical purposes, not to participate in the general circular movement of the planetary system; and when crossing the plane of the ecliptic they will therefore be altogether stationary, and under the same influences as the sun himself.

Now let us follow a comet in its passage from outer space to this particular point. When it first makes its appearance we see it through our telescopes as a faint, hazy, undefined body, which appearance very probably results from a deficiency of power in our instruments. As it approaches the sun, short streaks of light spring forth sunwards, or rather an electric discharge passes from it towards the sun, owing to its having been formerly the rubber, and consequently endowed with a different kind of electricity. As it gets further within the influence that (according to this theory) forms a sun, a repulsive action takes place between it and the sun, owing to their now being charged with the same kind of electricity; in fact, for the time being, it becomes a sun, and emits light in the direction of the rubber, or outer planetary matter, in the same manner as the sun himself.

Throughout our statements we have been making use of these two powers, motion and attraction; but if these speculations be correct, attraction is but the product of the action of motion upon mass, in the same manner as light and heat are the outcome of the action of motion upon attraction. It consequently follows that the one must balance the other, and that there is no immediate likelihood of our being drawn into the sun through the agency of a resisting medium, as any such retarding influence would have the effect not only of reducing our speed, but also of lessening the attraction.

R. Lamont.

ANALYSES OF BOOKS.

The Scientific Evidences of Organic Evolution. By G. J. Romanes, M.A., LL.D., F.R.S., Zoological Secretary of the Linnean Society. London: Macmillan and Co.

This work is simply what it professes to be,—an epitome of the Darwinian doctrines presented in a clear and concise form, so as to meet the requirements of the busy and of the indolent. The author remarks the common " ignorance of the *Origin of Species* shown by many persons who can scarcely be said to belong to the uncultured classes." Nowhere, we may add, is this ignorance more dense than among the average hostile critics of Evolution. There still spring up from time to time men who, with no previous knowledge of any department of Biology, dip carelessly into the works of Darwin, Wallace, and their coadjutors, and rush forthwith into print with the grandiose aim, forsooth, of overturning the new Natural History and restoring the age of Cuvier. It would be well if such persons—and we have one of the class in our mind's eye—would condescend to read, patiently and candidly, Mr. Romanes's little book; they might arise wiser and humbler men.

The author sets out with an explanation of " natural selection," or the " survival of the fittest," as the inevitable consequence of that " struggle for existence " which everyone must admit to be raging around us. It is curious that a recent anti-Darwinian writer has assumed the three terms we have placed between quotation marks to be the names of three distinct principles.

It may, perhaps, be said that Mr. Romanes has scarcely been sufficiently careful to guard his readers against a common error, especially dangerous when the principle of natural selection is applied to social science. " The survival of the fittest " means, plainly enough, the survival of those creatures which are most in harmony with their surroundings. Were this point kept in view there could be no misunderstanding. But such expressions as " The *strongest* will be victorious," " Nature selects the *best* individuals," " Only the *flower* of the race is allowed to breed," &c., are, to our certain knowledge, misinterpreted to mean the strongest or best in some abstract sense. Now there can be no doubt that certain extinct Carnivora would in fair fight vanquish any surviving species. Nor, passing to another plane, can we deny that the men who fail in life are often better, both physically and intellectually, than the men who succeed. But the former are less in harmony with a foul social atmosphere.

Another important consideration which Mr. Romanes brings forward in his Introduction relates to the "design question." Not a few persons—even those of high, though not scientific, culture—are apt to argue "the fact that these innumerable cases of adaptation may be accounted for by natural selection is no proof that they are not really due to intelligent design." The author justly contends that this objection involves a "radical misconception of the whole logical attitude of Science." The principle called by Sir W. Hamilton the "law of parsimony" forbids us to seek for higher causes when lower ones are adequate to explain the phenomena observed, and this law, as Mr. Romanes pointedly observes, is "the only logical barrier between science and superstition." For if phenomena are to be referred to the immediate operation of some supernatural agent, Science becomes impossible.

Mr. Romanes draws, however, a distinction which is too often lost sight of. In rejecting, in our opinion with perfect right, the teleology of Paley, Chalmers, and the Bridgewater essayists, he makes a reservation in favour of a higher form of the theory of design. He writes—"I hold that Mr. Darwin's theory has no point of logical contact with the theory of design in the larger sense, that behind all secondary causes of a physical kind there is a primary cause of a mental kind. Therefore throughout this essay I refer to design in the sense understood by the narrower forms of teleology, or as an *immediate* cause of the observed phenomena. Whether or not there is an *ultimate* cause of a psychical kind pervading all Nature, a *causa causarum* which is the final *raison d'être* of the Cosmos, this is another question, which, as I have said, I take to present no point of logical contact with Mr. Darwin's theory, or, I may add, with any of the methods and results of natural science."

The author, having thus cleared the way, goes on to present in succession the various kinds of evidence for Organic Evolution.

First comes the argument from classification. Here we find mention of a "very comical disquisition in one of Buffon's works on the question as to whether or not a crocodile was to be classified as an insect; and the instructive feature in the disquisition was this, that although a crocodile differs from an insect as regards every conceivable particular of its internal anatomy, no allusion at all is made to this fact, while the whole discussion is made to turn on the hardness of the external casing of a crocodile resembling the hardness of the external casing of a beetle; and when at last Buffon decides that on the whole a crocodile had better not be classified as an insect: the only reason given is that as a crocodile is so very large an animal it would make 'altogether too terrible an insect.'" May we not venture to suggest that Buffon was here indulging in a sly joke?

We can scarcely agree with Mr. Romanes when he remarks, concerning the tree-like system of classification, that "no one, even long before Darwin's days, ever dreamed of doubting that this system is in reality what it always has been in name,—a natural system." That strange school founded by MacLeay and Swainson, which at one time considered itself the embodiment of zoological philosophy, would have most emphatically protested against the notion of representing the animal kingdom, or any of its divisions, under the form of a tree.

The second chapter gives the argument from morphology, and shows clearly, though briefly, the principal difficulties which lie in the way of the separate creation, or rather origination, of organic forms. Under this head we meet with a consideration which the author believes is original, and which we do not recollect having found elsewhere. He writes—"We scarcely ever meet with any great departure from the typical form—such as the absence of limbs—without some of the other organs in the body being so far modified as of themselves to indicate, on the supposition of descent with modification, that the animal or plant must have been subject to the modifying influences of a long series of generations. And this combined testimony of a number of organs in the same organism is what the theory of descent would lead us to expect, while the rival theory of design can offer no explanation of the fact that when one organ shows a conspicuous departure from the supposed ideal type, some of the other organs in the same organism should tend to keep it company by doing likewise."

In the third chapter we find, very briefly, the argument from geology, and in the fourth that from geographical distribution. Next follow in succession the evidences from embryology, and finally certain arguments drawn from general considerations.

We are not surprised that our late illustrious leader formed a favourable opinion of the abstract of his doctrines here presented, and we feel confident that, if only widely circulated and fairly read, it will open the eyes of the many who in this country still cling to the old Natural History.

A Rational Materialistic Definition of Insanity and Imbecility, with the Medical Jurisprudence of Legal Criminality, founded upon Physiological, Psychological, and Clinical Observations. By Henry Howard, M.R.C.S. Eng. Montreal: Dawson Brothers.

This book, which bears also the title "The Philosophy of Insanity, Crime, and Responsibility," is dedicated, in grateful remembrance, to the President and Court of Examiners of the Royal College of Surgeons, London. A sort of key-note to the work is found in the Preface, to the effect that the animal mind, as we know it, is the product of organic matter, and that consequently insanity is a physical disease. These convictions have been reached not as the result of reading, but by dint of observations, physiological, psychological, pathological, and clinical. The author distinguishes imbecility, the result of a teratological defect,—or, as it would be popularly called, of monstrosity,—from insanity, the result of pathological defect, that is, of disease whether of an originally properly developed or of an abnormal brain. Imbecility he regards as an intermediate stage between idiocy and intellectuality. He recognises man as the "highest animal type," but pronounces him "the only self-conscious animal"—a somewhat hazardous dictum. We are here struck with a note from the "Chicago Medical Review":—"Dr. J. Kiernan called attention to the fact that the importance of the frontal lobes has been much over-estimated. He claimed that in the occipital lobe were to be found the great association centres of the brain, and, as upon associating power depended man's intelligence, the full development of the occipital lobe was necessary to constitute a well-balanced cerebral system. He cited as corrobatory evidence the fact that the occipital lobes are last to make their appearance in the fœtus. The occipital lobe was markedly deficient in reasoning maniacs."

Dr. Howard, whilst fully admitting degrees or stages in insanity, denies the existence of partial insanity. "A man," he writes, "has but one mind, and that mind, a unit, either is or is not insane. We might as well say that a man had a partial typhoid fever as that he was partially insane." He holds that insanity "is due to a mechanical lesion or chemical change in the sensory nerves and organ of consciousness, which changes render the parts in question anæsthetic: consequently false intelligence, if any, is borne by the sensory nerves to the organ of consciousness, or that organ itself is incapable of receiving intelligence because of its abnormal state. Under any of these circumstances consciousness is deranged or confused to a greater or less degree, intelligence is arrested or dethroned, reason has lost its pilot, reflex action to a great degree takes its place, and the result is insanity."

We are much gratified to find that Dr. Howard recognises the rationality of animals. Says he—"The more we study their actions the more we are convinced there are animals that reason as well as man." We might almost regard this as a test-question to decide whether or no a man is capable of faithful observation.

The following is exceedingly noteworthy:—"I have constantly remarked that at different times there will be a rush into the asylum from some particular locality." This fact the author suggests may be due to some specific poison present in the atmosphere.

We may now turn to Dr. Howard's general conclusions. These are:—

Firstly, that body and mind are one,—that is, the mind of man, as we know it, is the product of matter, as we know and define matter. Those persons who may feel inclined to denounce the author as a "materialist" will do well to consider certain reservations made on p. 20, where he says—"By this identity of mind and matter I refer simply to the manifestations of mind during this life through its material medium, the body."

Secondly, that insanity is abnormal mind, the consequence of abnormal matter,—therefore a purely physical disease. This conclusion is flatly at variance with, and much more practical than, the view held by not a few jurists and theologians, that insanity is sin.

The ninth conclusion is of an exceedingly serious character. The author writes "that every normal man has under certain circumstances a free will, but every intellectual man, according to my definition of an intellectual man, has a free will by which he controls all his desires. Consequently such a man would not, if he could, be guilty of a crime against society. Before he could be a criminal there must be a physical change in his mental organisation rendering him insane, and consequently irresponsible for his acts." This contention, as we understand it, amounts to a general plea of irresponsibility for all criminals.

In his tenth conclusion he asks "Does the fear of punishment act as a preventative to crime in any person?" The author seems to answer his own question in the negative, and adds—"If ever any means had a fair trial for the prevention of crime it has been punishment, with what effect criminal history can answer."

We think a reply to these views is not far to seek. If the fear of punishment does not prevent crime, how is it that so many offenders carefully and eagerly scrutinise the law in order to find some loophole which may enable them to effect unrighteous ends without peril? Punishment can scarcely be said to have had a fair trial for the prevention of crime. In England it has been stultified by the fundamental error of treating offences against the person more leniently than those against property. Sometimes it has been indiscriminately severe, and sometimes as indiscriminately lenient. It has rarely made a sufficiently broad distinction between the incidental crime into which a man may be led by the pressure of want and the formal war against society for which the burglar and the garrotter deliberately equip themselves. Even as it is we may fairly assert that had there been no punishment crime would be far more prevalent, just as if we had no medication disease would be more rampant. Nature acts on the principle that the species, the race, is of more moment than the individual. Did we follow her guidance we might stamp out ruffianism as decidedly as genius has been stamped out in Spain. But some of our moralists foster crimes of violence—and in one case disease also—just as distinctly as the receiver of stolen goods cherishes theft.

The author, however, we are glad to perceive and to declare, does not propose to turn dangerous criminals loose upon society as is done by our ticket-of-leave system, under the absurd notion that submission and quiet demeanour during imprisonment prove that the offender is reclaimed.

On the question of free will the author writes:—" No intelligent man can possibly believe that a man's will is always free, when we see the number of persons whose whole lives have been controlled by the will of others, so that they became mere automata. Who if he had a free will would ever allow memory to haunt him, thinking of a thousand things of the past to render him unhappy. Most certainly we cannot always govern our thoughts by our will, and it is equally certain that we cannot by our will govern our desires, words, and deeds. Mere children have no will, yet we in our folly treat them as if they had."

We cannot admit all this : we admit that we cannot completely control our thoughts, but the words and deeds of a normal man are at his command. Most parents find that children manifest a will at a very early age.

This work, containing much which we approve, and, on the other hand, also no little from which we differ, is worth careful reading. An index or table of contents would have increased its value.

The Law of Kosmic Order: an Investigation of the Physical Aspect of Time. By Robert Brown, Jun., F.S.A. London : Longmans and Co.

The reader may well be disposed to ask how a law of cosmic order can be reached by any analysis of ancient myths and traditions, or by any inquiries into the roots of words. Unless he has a power of reading between the lines, and discovering there something which escapes our ken, he will not find any fully satisfactory answer to his question.

Mr. Brown undertakes to show how the zodiacal signs, " which seem to us so singular, attained their present position by a process so natural as to be almost inevitable ; in fact by virtue of that simple law of re-duplication which, combined with the anthropomorphic principle, is the key to the vast majority of mythic fancies." He discards as baseless " theories which connect the Signs of the

Zodiac with deep significance, either religious, philosophical, or scientific," and in so doing he has our hearty sympathies.

In his first section, treating on the importance of ascertaining the mental standpoint of archaic man, Mr. Brown makes a very suggestive remark. He considers that "the gap between past and present"—and the consequent difficulty we men of the nineteenth century experience in putting ourselves in the place of our remotest forefathers—"is not so much occasioned by the multitude of wonderful discoveries and inventions; it arises rather from our familiarity with the ordinary adjuncts of human existence, and the general appearance of the universe in its customary succession of changes; a familiarity which has produced not indeed contempt, but certainly indifference, a state of mind well summed up in the dictum that 'no servant-girl is surprised at the sun'"—an adage evidently of non-British origin. But was man ever surprised at the sun? If so, he must have been in all probability suddenly placed upon the earth, and not gradually evolved from lower organic forms, and must furthermore have been, if not a being of high culture, still not a savage of the lowest type.

The reader thus finds himself led up to one of the burning questions of the day which the author does not indeed discuss, but it appears somewhat plainly what view he embraces. He writes:—"We have thus the three universal concepts of Space, Time, and Number; common to all men, necessities of thought, and hence primary truths." From the working out of the time-concept Mr. Brown considers that man was led to recognise the reign of law and the harmony of the world. Further, this recognition of law and order enables man to express fully his innate ideas of right, justice, law, and the like, but does not furnish him with these ideas."

But the great question is, Are the concepts of time, space, and number, and the idea of justice, not merely common to all men, but peculiar to man as compared with the lower animals? The author's reply may be plainly gathered from the concluding sentence of his treatise:—"So as man became conscious of the splendour and harmony of the external world, did this enable him to express and assist him in comprehending and defining those great ideas and noble feelings which sever him from every other animal." We naturalists who patiently observe the actions of animals come to a very different conclusion. We find among social species, such as rooks and ants, distinct traces of positive law which presuppose the idea of justice. Even among non-social species we recognise the sentiment of property, and we note that, when going beyond their rights, conscience makes cowards of them as it does of men. We likewise see that they recognise a law of cosmic order, an "order of Nature," and on witnessing any apparent departure therefrom they display a superstitious dread akin to that shown by savages at some supposed portent or miracle. In like manner the concepts of number, time, and space are not wanting among brutes, as any candid inquirer may easily find to his satisfaction.

We are compelled further to differ from the author when he says "the higher instincts of our nature are independent of the observation of natural phenomena, or otherwise they would be absent in one born blind." Surely no one contends that the instincts of a species originate *de novo* in every individual of such species! Are they not the product of successive generations, handed down, like structural peculiarities, from parent to offspring?

A Manual of the Geology of India. Part III.—Economical Geology. By V. Ball, M.A., F.G.S. Calcutta: Office of the Geological Survey of India. London: Trübner and Co.

This volume will clear away two opposite errors. It will, on the one hand, dispel some of the sensational visions of untold wealth to be gained from Indian mines, but it will also overturn the contemptuous estimates of the mineral deposits of the country in which some writers have indulged. It is true that English lead, copper, and iron are underselling the indigenous products; but, on the other hand, both Government and private companies have worked coal- and salt-mines and stone-quarries with very great profit. In the course of the next few years "the capabilities of India not only as a gold-producing country, but also in reference to other metals," will be fairly tested. The task of the officials of the Geological Survey has not been easy. The area to be worked over is immense in comparison with the time allowed and the number of investigators; and, in addition, the natives are not merely disinclined to furnish information as to the mineral wealth of the several districts, bat even take steps to prevent the deposits from being discovered. The Survey, however, under all difficulties, has proved the possibility of certain minerals occurring in given tracts, and has conclusively shown the futility of searching for them elsewhere.

The first chapter treats of the diamond, graphite, and amber. Golconda (Kala-kandar), it appears, never produced diamonds, but was merely the mart where they were bought and sold. The three chief localities in which diamonds have been found, and may be sought for with some prospect of success, are on and near the Godavari, between this river and the Mahanadi, and in Bundelkhand. They occur in the lowest beds ot the Vindhyan formation. It appears probable that the original matrix of the

Cape diamonds belongs to a horizon directly comparable with that which includes the Indian diamonds.

The author considers it probable that diamond has been formed by crystallisation from a liquid hydrocarbon, the carbon having, according to Liebig's views, been purified by the gradual elimination of CH_4. The experiments of Sir D. Brewster render it at least probable that the diamond must have been at one time in a soft state. The author thinks that the Koh-i-nur is the basal portion of the Great Mogul diamond. It has been suggested by native authorities that the original name of this stone was the Kollur diamond. "Such changes, in which, while the sound is more or less retained, a meaning is acquired, are not by any means rare in Oriental languages."

Graphite occurs in various parts of India, and samples have been brought to England. Whether they will ever become of commercial importance, like that found in Ceylon, is open to doubt. In some localities a workable thickness cannot be obtained, whilst in others the mineral is contaminated with silica and iron. The former impurity, when occurring, renders graphite unfit for use in pencils and as a lubricant, whilst iron spoils it for the manufacture of crucibles.

The only source of amber in India appears to be in Burmese territory.

The next chapter treats of coal, peat, and petroleum. The rocks in Peninsular India, which probably correspond to the true carboniferous rocks of Europe, bear no coal: the useful coal of the Peninsula is of Permio-triassic age. Beyond the Peninsula coal is found in more recent deposits. The coal-bearing areas of India are estimated by Mr. Hughes at 35,000 square miles, though it must not be supposed that workable coal exists everywhere in this region. Much injury has been occasioned by the carelesness and ignorance of persons who have undertaken to work the deposits. One of the plates represents a "gin," in which the motive power is supplied by — women!

A curious fact is here mentioned, *i.e.*, that the operations of the coal-ring in 1872, which produced such disastrous results in England, did not perceptibly affect the price of fuel at Calcutta.

True peat only occurs in tropical regions in upland districts where the climate is substantially temperate. It is met with in the Nilgiris, and if rationally utilised might lessen that destruction of the forests which has wrought such mischief in many tropical and sub-tropical regions.

Petroleum is entirely absent in Peninsular India, but it occurs in Pegu, Arracan, Assam, &c. In the Punjab wells exist which a specialist, Mr. Lyman, estimates might produce 100 gallons of oil daily for eight years, after which the supply would probably fail. It is noted that in India, just as in Pennsylvania, petroleum and brine springs occur simultaneously,—a fact which seems to indicate that the formation of petroleum is in some unknown manner connected with the presence of salt. The wells in British Burma are of much more importance, a well in Eastern Baronga having at one time yielded 1000 gallons a day.

The deposits of sulphur in India are of little importance, and are situate chiefly in localities difficult of access. Arsenic and bismuth are also found, but sparingly. Concerning the latter metal we find the curious remark that it enters into the composition of mordants for calico-printing. We are not aware that it has ever been used for this purpose on a practical scale.

An enormous lode containing antimony ores (stibnite, cervantite, and kermesite) has been discovered at Shigri, in the Punjab. Platinum occurs in a number of localities on the small scale.

Tradition points to the existence of mercury in the Andaman Islands, but no proof has been obtained.

That the ruling dynasties of Southern India at one time possessed vast quantities of gold is beyond doubt. Whether the deposits have become exhausted, or whether the precious metal may still be obtained in remunerative quantities, will probably soon be decided by the operations of mining companies in the Wynaad and elsewhere. A number of the natives in the auriferous districts occupy themselves with gold-washing, but their earnings are described as generally but trifling.

Tin is met with in remunerative quantities in the Tenasserim district.

Cobalt occurs in Nepal and Burma. It is used by the native jewellers in colouring enamels and bangles blue, and in producing a fine rose-colour on gold by a process unknown in Europe, and preserved as a secret in certain families.

In like manner the author works over all minerals useful in the arts and manufactures, pointing out where they have been discovered, or actually raised on a practical scale, and discussing the probability of their being made remunerative. The results of this comprehensive survey must be pronounced, upon the whole, somewhat disappointing to those interested in the prosperity of India. Still it must be remembered that the Geological Survey of India has been able to give as yet little beyond a broad general sketch. Even in Britain, where explorers are a hundredfold more numerous, and where they meet with so much greater facilities, valuable deposits of minerals are still from time to time discovered. It is therefore far from unlikely that such will be the case also in India.

Geological and Natural-History Survey of Canada. Report of Progress for 1879-80. By Alfred R. C. Selwyn, LL.D., F.R.S., Director. Montreal: Dawson Bros.

This volume opens with a general report by Mr. Selwyn on the work of the season. We learn that the explorations and surveys undertaken during 1880 embrace the North-western territories with the Souris River Coal-fields, Manitoba, the Quebec district on both sides the St. Lawrence, New Brunswick and Nova Scotia, and the Magdalen Islands. Several collections of fossils have been examined, including a small series of fluviatile mollusks from the Lignite Tertiary of the Souris River, Manitoba; about ninety fossils from the Palæozoic and Devonian of the Pine, Battle, Burnt, and Elk Rivers, in British Columbia; a series of Cretaceous fossils from the same region; Lower Silurian and Devonian fossils from the Red River, Manitoba; and fishes from the Devonian of Scaumenac. The chemical laboratory has been engaged in analysing lignites, iron, copper, and manganese ores, specimens of graphitic rocks, minerals containing the precious metals, determinations of nickel and cobalt in pyrholite from different localities, &c.

The Director complains, not without reason, that the sum of 50,000 dollars annually voted by the Dominion Parliament is very insufficient to carry on explorations extending from the Atlantic to the Pacific, to support a museum, laboratory, and library, and to publish the results obtained in two languages.

Of particular interest is the special report on Hudson's Bay and the adjoining country, by Dr. Bell. At York Factory, on the shore of this Bay, which has been called the Mediterranean of North America, the first rain of the year falls about the end of April, the last snow occurs towards the end of May, whilst the first snow-fall of the next winter varies from the 8th to the 28th of December. During the summer the rainfall is at times exceedingly copious, 4·3, 6·5, and 7·6 inches of rain being recorded each in a single day. The short summer, however, is generally fine, and the soil productive, so that the country is by no means unfit for agriculture. Minerals, however, must constitute the greatest of the resources of the surrounding country. The author reports inexhaustible supplies of good manganiferous iron ore on the islands near Eastmain coast, galena round Richmond Gulf, rich ironstone on the Mattagami, as well as lignite, petroleum-bearing limestones, sulphur ores, soapstone, and graphite. Dr. Bell considers Hudson's Bay and its region important, not merely to Canada, but to the entire Empire, because the future highway from Britain to the great North-west of the Dominion may pass through it. The Nelson Valley Railway Company have surveyed the country from Churchill Harbour to

Lake Winnipeg, and find the country easy and inexpensive. York Factory is nearer to Liverpool than is New York. The proposed line will afford a route for the introduction of emigrants which will entirely avoid the United States and the populous parts of Canada, and, on the other hand, will afford a convenient outlet for the North-west territories, which "embrace hundreds of millions of acres of fine lands destined to become the greatest wheat-field in the world."

A very interesting portion of the work of the Survey has been the mapping out of thirty of the principal forest trees of the Dominion, showing their northern limits. The map constructed is of no small importance, both botanically and from a climatological point of view. The conclusion is drawn that the present divisions of prairie and woodland are of very ancient date, and are not due to forest fires.

As appendices to this Report we have a list of plants collected in the Hudson's Bay country, running to the number of 261. The majority of these belong to the Ontario flora. There is a list of Coleoptera, collected in 1880 in Manitoba, and between Lake Winnipeg and Hudson's Bay. The forms, as might be expected, are boreal. The Lamellicornes are few and small, the Buprestidæ and Elateridæ scanty, and the Longicornes less developed than might have been expected in a richly-wooded country.

The report on the Magdalen Islands, a small group situate in the Gulf of St. Lawrence, is accompanied by a local flora, from which it would seem that the climate is scarcely warm enough for the cultivation of wheat.

The flora of Nova Scotia is characterised by ferns, which, for North America, are numerous both in species and individuals. It is to be noted that many species are common to this region and to Britain, such as *Polypodium vulgare*, *Pteris aquilina*, *Asplenium Trichomanes*, *A. Filix-fœmina*, *Phegopteris Dryopteris*, *A. Filix-mas*, *A. lonchitis*, *Osmunda regalis*, &c.

It is to be hoped that the Dominion Government will not allow Mr. Selwyn's hands to be tied from want of the necessary funds.

Geology of Wisconsin. Survey of 1873—79. Vol. III. Published under the Direction of the Chief Geologist, by the Commissioners of Public Printing.

Not a few of the States of the American Union are displaying no less zeal in the geological examination of their respective districts than is the Federal Government in its grand survey of the so-called "territories." The diligence of Wisconsin in this important task will be more fully appreciated if we remark that the volume before us—the third of the "final report" of its survey—extends to 763 large and very closely-printed pages, abundantly illustrated with maps, plans, sections, views of characteristic scenery, &c.

The Report comprises, in its main divisions, the General Geology of the Lake Superior Region, by R. D. Irving; the Lithology of the Keweenawan or Cupriferous System, by Raphael Pumpelly; the Geology of the Eastern Lake Superior District, by R. D. Irving; the Huronian Series west of Penokee Gap, by C. E. Wright; the Geology of the Western Lake Superior District, by E. T. Sweet; the Upper St. Croix District, by the late Moses Strong; the Menominee Region, by T. B. Brooks; and the Economic Resources of the Menominee Iron Region.

The entire extent of Wisconsin presents much that is highly interesting to the geologist. The series of strata measure about 100,000 feet in thickness, and include four great systems,—the Laurentian, the Huronian, the Keweenawan, and the Lower Silurian, each uncomformable to its predecessors.

Concerning existing theories on the origin and age of these formations, and of the structure of the trough of Lake Superior, the author regards most of them as hasty. The Keweenawan is characterised as the "copper-bearing" system. Copper, indeed, constantly accompanies these rocks throughout their entire extent in Michigan and Wisconsin, and is associated with silver, though in small quantities. The Menominee region, on the other hand, contains abundance of iron in the Huronian system. It appears that an earlier survey of this region, executed under the orders of the Federal Government, is not merely "entirely inaccurate, but absolutely fraudulent and false." A certain "Spread Eagle Lake" was not only never surveyed, but apparently was seen only in part by the Deputy Surveyor, who swore to having traversed and mapped it according to his contract.

We find some interesting observations on the climatology of the Lake Superior country. The mean annual temperature at the lake shore is 38° F.—certainly low for the latitude. The spring months show a mean temperature of 34°, summer 62°, autumn 40°, and winter 15°. Winter sets in about the end of October. It is mentioned that in 1877, though an early season, the snow was all gone by the 1st of May, though "ice was found in the swamps two or three weeks later." Strawberries ripen on the south slope about the 1st of August, and on the north slope from the middle to the end of August. In the main body of Lake Superior the water, which is of exceptional purity, never exceeds the temperature of 46° F.

Concerning the fauna and flora of the region we find but little information. Beasts of prey are rare. There are very few birds; indeed it is said that a person may travel for a day in the woods, in spring or autumn, without meeting half a dozen. As may be inferred from the geological character of the region, there is but a very scanty harvest for the palæontologist. In the list of trees we find the name "tamarac" given to *Larix americana*. But the "hemlock" (*Abies canadensis*) is said to have a bark very rich in tannin; and, unless we are misinformed, the substance met with in commerce under the name "tamarack," and used to some extent by tanners and dyers, is obtained from the latter tree.

Memoirs of the Geological Survey of India. Vol. XVI., Part 3. Calcutta: Geological Survey Office. London: Trübner and Co.

This part gives an account of the Upper Gondwanas, and other formations of the coast region of the Godavari district. There is a particular description, with an illustration of the gorge of the great Godavari river, in which the water is said, in flood-time, to rise 100 feet above its ordinary level.

We find the curious remark, in a note, that the Kaurkonda Hill is "one of the few spots in this part of the Presidency still frequented by *bison*." Just as the Americans call the true bison of their country "buffalo," it appears that certain Anglo-Indians invert the error.

One part of this district is reported to have yielded diamonds, but the old workings are quite abandoned. Iron ore is abundant, but smelting is limited by the scanty supply of fuel.

Vol. XVIII., Parts 1, 2, and 3.

The first of these parts deals with the geology of the section between the Bolan Pass and Girishk, in Southern Afghanistan; the second comprises the geology of the districts of Mánbhúm and Singhbúm; and the third gives the geology of the Pránhita-Godávari Valley. It appears that till lately gold was obtained in considerable quantities near the city of Kandahar, where it occurs in quartz veins traversing the zone of contact between the hippuritic limestone and the trap outbursts. Some of the nuggets obtained were of the size of a man's fist. A poor ore of copper is found in the Kojak-Amran Range, and a richer ore is now being worked in the Shah Makhsud Range. Lead occurs in many localities in Southern Afghanistan. Argentiferous galena and native silver are said to occur in the Hazarah country, at Siah-Sang and at Herat. Petroleum springs exist in the Marri

Hills, but have not been examined. Coal is found in thin seams near Sharigh, but in the author's opinion would not repay working. In Mánbhúm and Singhbúm gold-washing is carried on by the natives, and their earnings, as compared with the price of field labour, are considered good. The manganiferous iron ores of Chárbásá will be of value for the manufacture of spiegeleisen if iron smelting is taken up on the large scale in the Rániganj coal-fields.

The Godávari Valley contains deposits of coal and iron, which may become of importance if the Godávari navigation is completed. The gold-washings of the district are inconsiderable.

John Bunyan and the Gipsies. By James Simson. New York: James Miller. Edinburgh: Maclachlan and Stewart. London: Baillière, Tindall, and Co.

We have had pleasure on a former occasion in noticing Mr. Simson's estimate of Charles Waterton; but with John Bunyan the "Journal of Science" does not and cannot concern itself, and consequently any question as to his nationality falls entirely outside our competence.

Journal of the Proceedings of the Royal Society of New South Wales, 1881. Edited by A. Liversidge, Professor of Chemistry and Mineralogy in the University of Sydney. Sydney: Thomas Richards.

This number of the "Journal of the Royal Society of New South Wales" is by no means so rich in scientific investigation as might be hoped from a body placed where there is so much novel matter to be observed. For this shortcoming the indefatigable secretaries, Prof. Liversidge and Dr. Leibius, cannot be held answerable. We know from private sources that they do their utmost for the efficiency of the Society; but if the bulk of the members and the outside public cannot or will not "work," where are papers and memoirs to be obtained?

We regret to learn that the financial position and prospects are not of the brightest. Were it not for a Government subsidy, of precarious duration, since dependent upon an annual vote of the Colonial Legislature, the efficiency of the Society would be seriously compromised.

We note with mingled feelings the proposal for the establishment of a biological station in the neighbourhood of Sydney. We are certain that such an institution could not fail to yield results of the highest interest and value. The unworked field in every department of biology is in that region immense and fruitful. But we cannot help feeling a certain share of humiliation that this praiseworthy undertaking should have been left to be set about by a foreigner—the celebrated Russian traveller, Baron Maclay—and that his zeal should hitherto have met with but a cool response. The Government has granted an eligible site at Watson's Bay, and has engaged to double the subscriptions up to £300, but the necessary £300 has not yet been made up. A small beginning has been made in a cottage, affording five work-rooms. It is not intended, as in Dr. Dohrn's far-famed station at Naples, to make a charge for each work-table or room, but it is proposed that every naturalist making use of the building should pay, say, 5s., weekly towards current expenses. Baron Maclay remarks that the "time has arrived when mere collecting should be abandoned, and when the great aim of scientific travellers should be observation and investigation, exercised immediately and upon the spot." He considers that "next after the tropics the widest field offered to the investigator of nature, and consequently the most suitable region for the establishment of zoological stations, is Australia." May we not hope that some among that numerous class of our readers who are specially interested in biological research will see their way to aid in the establishment of the Watson's Bay Station?

The papers in the present number of the Society's "Proceedings" are "The Climate of Mackay," a port on the east coast of Queensland, by H. L. Roth, F.M.S.; "Notes of a Journey on the Darling," by Mr. W. E. Abbott, a record of topographical and geological observations, with important suggestions on the greatest practical problem of Australia,—the obtaining an ample and constant supply of water. The Rev. P. McPherson contributes a paper on the "Astronomy of the Australian Aborigines." Mr. H. C. Russell writes on the "Spectrum and Appearance of the Recent Comet." The same author communicates memoirs on "New Double Stars and Measures," and on the "Transit of Mercury of November, 1881." Mr. W. A. Dixon, F.C.S., gives some interesting particulars on the "Inorganic Constituents of Epiphytic Ferns," the result of his inquiries being that the fronds contain a much larger proportion of mineral matter than would be looked for in plants growing not in direct contact with the soil. Baron von Mueller, F.R.S., contributes a "Census of the Genera of Plants Indigenous to Australia,"—a document valuable for reference, but of course unsuitable for quotation or discussion.

"Notes on Wool," by P. N. Trebeck, contains some interesting matter. It appears that the spear grass of the coast country, near Rockhampton, pierces through the skin and flesh and kills sheep in a few days.

Victorian Year-Book for 1880-81. By H. H. Hayter, Government Statist. Melbourne: Ferres. London: Robertson.

We find here an extensive assortment of useful information. The general salubrity of the Australian colonies is still maintained, the general death-rate for the whole group including Tasmania and New Zealand, being, on the years 1873 to 1879 inclusive, only 15·44 per thousand, which is more favourable than that of any European country from which accurate returns are obtainable. The most fatal disease, as in England, is phthisis, and next to it diarrhœa. Cancer ranks *eight* in the scale.

As regards the criminal statistics, drunkenness figures with sad prominence. Out of a total of 23,983 persons arrested in 1880, no fewer than 10,056 were for drunkenness. As regards the birth-place of the offenders, it appears that 7359 criminals were Irish, 6188 English or Welsh, persons born in Victoria 5688, and Scotch 2008.

A very painful fact is that the phylloxera succeeded in establishing itself in the Geelong district as far back as 1875, and though it has not spread into any other part of Australia, all the measures tried for its extirpation have proved fruitless.

It appears that the inhabitants of Australia consume a larger proportion of animal food than the population of the home kingdoms. This circumstance, as may be judged from the death-rate, does not appear to have an injurious effect on their health or longevity,—a fact which dietetic reformers would do well to consider.

CORRESPONDENCE.

*** The Editor does not hold himself responsible for statements of facts or opinions expressed in Correspondence, or in Articles bearing the signature of their respective authors.

THE CLIMATE OF WEST AFRICA.

To the Editor of the Journal of Science.

Sir,—In the Notes of your issue for August is a note as follows (p. 500):—" On the West coast of Africa teetotallers die first, hard-drinking men second, whilst the temperate live longest." I have had some considerable experience of living on the West coast of Africa. Take the " temperate " in the largest sense the remark is true. A man may be temperate in the use of alcoholic drinks, but intemperate in eating, which I think is more fatal than the use of liquors and wine: these latter in a great degree counteract the effect of the miasmic exhalations. Gorging the system with solid substances makes it more apt for the introduction of fever germs, and is without the corrective effects of alcohol. The usual course of meals adopted was as follows:—At 6 o'clock a.m. coffee and bread or biscuit: at 11 a.m. a dinner of several dishes, omitting soup and substituting tea or coffee (wines of course). Dinner at 5 or 6 p.m. The breakfast repeated on a large scale, with soups. At both these meals the participants indulge freely (as a general rule).

My observations showed that excessive eating was more fatal than excessive drinking. As a rule the climate was most fatal to new comers who were Germans. The mode of dress—but that is now corrected—was flannel next the skin, long cloth shirt, and a vest and outer coat of a thick close-thread texture. The consequence was that persons so clothed were always hot and uncomfortable, a clammy moisture continuously clinging to the skin, owing to the arrest of the exhalations by the outer coat. The reform was as follows.—Long cloth shirt next the skin, and outer garments of woollen substances. The exhalations of the body passing through the shirt were quickly passed through the wool, and left the skin moist but not clammy.

There came under my observations three persons who did not perspire; they all died within two months of their arrival. There is also a curious physiological fact which I observed, but have never seen it remarked on, *viz.*, that the skin of the negroes when in health—even when streams of perspiration were pouring down them—was to the touch as cold as marble; heat on the skin was to them always an indication of fever.

In the year of my advent on the coast there were twenty-one new comers—five Englishmen and sixteen (principally) Germans. Out of the twenty-one fourteen died, four Englishmen (one of whom did not perspire); the other ten were Germans. Those who died were intemperate, mostly in eating. As a rule excess in drinking is not exhibited, new comers being warned against it. Brandy and water drinkers fared worse than wine drinkers. Beer, in my opinion, is almost poison.

I may remark that I had a very severe attack of malarial fever contracted in the interior, and had to ride on horseback, whilst under its influence, nearly 30 miles. But for this, and its influence in the nature of *black* boils, which I suppose to be an effort of Nature to purge the blood of the poison, and a severe inflammation of the eyes, during my residence on the coast of between five and six years, I had not even a finger ache.

The bad name given to the West coast of Africa arises more from the excesses of its exotic denizens than from the real effects of the climate. After the acclimative fever—which all have more or less severely—the health of the old denizens is good; a little fever sometimes, and that is all. I do not think that a more pleasant (and, I may say, healthy) climate can be found than the West coast (Gambia I am speaking of) of Africa from the end of October to the commencement of June. From June to October is bad enough. August is generally the most fatal month to new arrivals.—I am, &c.,

S. BILLING.

SIZE OF HEADS.

To the Editor of the Journal of Science.

SIR,—Your note on the decrease of size of hats between 1855 and 1880 does not seem to take into account the present fashion of cropping the hair: this alone would account for the decrease of hats without decrease of heads. As brims now give more shelter than those of 1855, the hats are now probably required to cover less of the head. Till these matters are taken into account smaller hats will not prove smaller heads.

There is another human variation to which attention might well be drawn, *viz.*, the greater size and strength of girls. I have no measurements, but observation convinces me that our daughters, especially of the middle and upper classes, are much taller than their mothers. Better exercise, better dress, and perhaps better food and air, might lead us to expect an increase in the height of our tennis-playing generation of girls, but I fancy it is more than would be expected—perhaps quite half an inch. Is this the first stage in the development of the late Lord Lytton's "Coming Race"?—I am, &c.,

HUGH BROWNE.

Nottingham, September 20, 1882.

INTELLIGENCE IN A HORSE.

To the Editor of the Journal of Science.

SIR,—The following incident may be interesting to some of your readers. It is well known that horses in some parts of South Africa are much annoyed by a kind of tick, which sucks their blood till it swells out to the size of a large pea. A charger named Joe, belonging to the Colonial cavalry stationed at Maseru during the Basuto War, if thus attacked whilst pasturing would canter to the fort, seek out his rider, and express by signs what was the matter. The trooper would seek out the tick, crush it, and throw it on the ground. The horse has then, on more than one occasion, examined the remains of its enemy, and given them a blow with his fore-hoof, as if to make "assurance doubly sure."—I am, &c.,

E. A. S.

OBJECTS SEEN THROUGH BLUE GLASS.

To the Editor of the Journal of Science.

SIR,—The glass used by your correspondent ("Journal of Science," September, 1882, p. 562) was in all probability the ordinary blue glass coloured with cobalt: this if examined with the spectroscope will be found, according to its depth of tint, to transmit more or less red light, which would account for some of the tints observed. The effect is easily seen in the lights of some tramcars which are coloured blue; in addition to the blue tint of the glass, a strong red colour may be observed about the light. I will examine the glass used if your correspondent wishes it.—I am, &c.,

W. T. SUFFOLK.

"FELLOW OR MEMBER?"

To the Editor of the Journal of Science.

Sir,—Can you inform me what entitles a Society to dub its constituents "Fellows" instead of Members? A legal friend tells me that only bodies incorporated under a Royal charter are duly entitled to make use of the former term; but there is at least one instance where a Society which has no such charter, but is merely enrolled under the "Companies' Act," has appropriated the more assuming name. Hence it would seem that if there is any positive law on the subject it is never enforced.—I am, &c.,

B. S. W.

A TALKING SWAN.

To the Editor of the Journal of Science.

Sir,—I have heard, on what I believe to be unimpeachable authority, of a swan which had learnt to utter a few words. The bird in question, an old female, lived in solitude on a large reservoir belonging to a woollen-mill near Huddersfield. Its vocabulary, picked up from the factory girls, was very limited, and of too "unparliamentary" a character to be quoted in the "Journal of Science." I never before heard of a bird belonging to this order acquiring human language.—I am, &c.,

Viator.

THE EFFECT OF TEMPERATURE ON FISH,

To the Editor of the Journal of Science.

Sir,—Having frequently been informed that carp could live at excessively high temperatures in the pools formed by the water which has been used for the slacking of slag in the black country, and also in the warm springs of Japan, I have made experiments to ascertain the limits of temperature which Prussian carp (*Cyprinus Gibellio*) can endure, and the results of these experiments clearly show that the truth is strikingly different from that which is generally supposed.

The greatest warmth that Prussian carp can stand is 96° F., or 2 degrees below the temperature of the human body, and a considerably greater number of degrees below the temperature of a warm bath. The greatest cold that this species can sustain is 2 degrees above the freezing-point, thus limiting their range of temperature to 62 degrees.

My experiments, however, have as yet been confined to Prussian carp.—I am, &c.,

A. Anthony Nesbit, F.C.S.

Laboratory, 38, Gracechurch Street.

AN ANTI-DARWINIAN ARGUMENT REFUTED.

To the Editor of the Journal of Science.

Sir,—A standing argument against the formation of new species by the preservation and accumulation of accidental divergencies from the original stock has been the contention that, if an individual possessed any structural peculiarity, such feature must soon disappear by successive matching with individuals of the normal structure. The following instance, which I copy from "Land and Water," proves that such disappearance is not necessarily the case:—

"About twelve months ago Mr. Peter Low, flesher, High Street, Montrose, bought a ram with four horns from a lady in town, which she had gained at a raffle at a church bazaar in Brechin. Mr. Low put the ram into a park with a black-faced Highland ewe, and the result was that the ewe gave birth to twins, male and female, on July 9th last, the ram having five and the ewe four horns, all well developed. The lambs are both strong and healthy.—N."

We see here that the ram, though mated with a normal ewe, transmitted his abnormal feature to his posterity not merely unimpaired, but in the one case even intensified.—I am, &c.,

Observer.

NOTES.

Literary Notice.—Mr. A. H. Swinton, author of "Insect Variety," is preparing for publication a Table of Sun-Spots and Earthquake Phenomena, by means of which many public calamities may be safely predicted. Any public institution or private individual desirous to assist in the publication of these useful observations, extending over the Christian Era, will kindly intimate the amount of their subscription, for which copies will be sent. The money will be returned unless the expense of publication is fully covered. Address, "Binfield House, Waterden Road, Guildford."

According to the daily papers at the Congress of Librarians recently held at Cambridge, Mr. E. B. Nicholson, the Bodleian Librarian, proposed a resolution in favour of the opening of libraries, museums, and art-galleries on Sundays, but it was not discussed, the "previous question" being carried by acclamation. Some of our contemporaries seem to regard this action as the outcome of a blameworthy selfishness. We rarely, however, find men of any class eager for an increase of duties without any corresponding increase of remuneration. Those who wish for the Sunday opening of museums, &c., should set their face, above all things, against the introduction of refreshment-rooms in such establishments. This modern blunder—we believe of South Kensingtonian origin—enlists a numerous, earnest, and well-organised body against the proposed Sunday opening.

We learn that a joint Annual Meeting of the two "Anti-Vivisection" Societies took place at the end of August. Besides the Rev. Mr. Grove and the inevitable Mr. Jesse there were present three men, four women, a small girl, and four reporters!

M. D. van Monckhoven ("Comptes Rendus") says the expansion of the central rays of hydrogen is absolutely independent of temperature, and is simply due to pressure.

A single shock of earthquake was felt at Couchey, in the Côte d'Or, early in the morning of August 14th. The barometer remained stationary, and domestic animals showed no disquietude either before or after the occurrence.

Prof. Wiesner, of Vienna, has continued the researches of Darwin on the power of movement in plants, and has brought to light many interesting facts.

According to "Ciel et Terre" the birds of passage which return early in the season, up to April 13th were, almost without exception, in advance of their ordinary times. From April 14th onwards they were almost as regularly too late.

The "Bookseller" places Miss Hunt's "Private Instructions in Organic Magnetism" under the heading "Charlatanism."

The "Popular Science Monthly" rightly says—"Two unregulated and overwhelming passions in this country stifle the growth of Science,—the intense and absorbing passion for wealth, and the universal infatuation for politics. These are great national diseases, not peculiar to America, but malignant in America, and the state of mind they engender makes the systematic cultivation of scientific thought next to impossible.

Dr. F. Oswald, in an article on longevity ("Popular Science Monthly") states that "London holds about the medium in death-rate between New York and St. Petersburg." All returns we can find assign a much higher mortality to New York than to London. The figures for three weeks taken at random are—New York, 34, 31, 30, as against London, for the same weeks, 21, 18, 17.

The "Economical Section" of the British Association, instead of being amputated, has been this year as active as ever, and appears, to us at least, to approach more and more to the character of a political debating club.

According to the Report of the Chief Inspector of Mines, in Victoria, a very large proportion of the accidents are due to the recklessness of the men.

The new equatorial of the Halsted Observatory, at Princeton, in New Jersey, now complete, is the fourth in size in the world. Its object-glass is 23 inches in diameter, and has a focal distance of 30 feet.

M. Spring (Belgian Academy of Sciences) concludes that the seat of the electricity of storms is not, as generally admitted, in the moist region of the atmosphere, but in the cold and dry superstratum.

M. Zenger ("Ciel et Terre") maintains that the hurricanes of the West Indies and the typhoons of the Chinese Sea have a period of twelve days, equal to that of the rotation of the sun.

Dr. Mackintosh has been appointed to the Professorship of Natural History in the University of St. Andrews *vice* Prof. H. Alleyne Nicholson.

According to M. L. Crié, Pierre Belon, of Mans, in a work published as early as 1558, originated the so-called binary nomenclature for animals and plants, the credit of which is commonly given to Linnæus. Belon also devised the classification of birds which has been substantially adopted by Linnæus and Cuvier.

At the late Congress of German anthropologists, at Frankfort, Prof. Virchow eulogised Darwin's work on Anthropology.

A disease among sugar-beets is spreading on the Continent. So perhaps, in spite of bounties, the sugar-cane may again become sole master of the situation.

Dr. C. W. Siemens, in his Presidential Address at the recent meeting of the British Association, mentions the Linnean among the " special Societies which have sprung into existence since the foundation of the British Association." As the Linnean Society was founded in 1788, and received its charter of incorporation in 1802, there is here a mistake either on the part of the speaker or of the reporter.

The woodpeckers in Norway bore into telegraph-posts, being misled by the humming sound into the belief that there are insects in the wood. The bears sometimes scratch away the heaps of stones put to support the pole, thinking that the noise proceeds from a nest of bees.

We find that the " Revue Coleopterologique " has ceased to appear.

Mr. Moore, in his " Lepidoptera of Ceylon," mentions that the caterpillar of the oleander hawk (*Daphnis Nerii*) feeds upon the cinchona as well as the oleander. This is a most curious fact if we consider how recently the cinchona has been introduced into Ceylon, and that the two trees differ most widely from a chemical point of view. *D. Hypothous*, a nearly allied species, feed also upon the cinchona.

The total number of known North American ferns is 156.

We learn that the Rev. W. D. Cowan is returning to Madagascar with the object of exploring the entomology of the southern portion of the island.

Mr. F. L. Harvey (" American Naturalist ") witnessed a female of the American woodcock (*Phitohela minor*) carrying her young one away from danger. She held the nestling between her legs, supporting it with her feet.

The Museum of Iowa College was among the buildings destroyed by the tornado of June 17th.

At the meeting of the Entomological Society, September 6th, Mr. McLachlan, F.R.S., exhibited a specimen of the " induvial " limestone from the Eocene formations of Auvergne, composed of the fossilised cases of caddis-worms, to each of which were attached a multitude of minute univalve shells. There are about ten or twelve cases to the cubic inch, and as the deposit, which underlies the lava, is about 6 feet in thickness, the number of specimens must be immense. No traces of the larvæ themselves remained.

Mr. J. Jenner Weir gave a communication showing that fishes as well as birds refuse to devour bright-coloured and hairy caterpillars.

Miss Ormerod described observations proving that the "rapecake" from India (mustard-cake) is destructive to wireworms.

The Midland Union of Natural-History Societies, founded in 1877, includes now no fewer than twenty-five local societies. It holds annual meetings during the summer, at which an account is given of work done, whilst the following day is devoted to botanical, geological, entomological, &c., excursions. Two local floras, respectively of Warwickshire and Leicestershire, are being prepared under its auspices. Geological researches are also being conducted. Many Coleoptera hitherto new to the Midlands have been discovered, and one or two species probably new to Science. The organ of the Union, the "Midland Naturalist," contains a number of very interesting papers, and puts on record many scientific observations which might otherwise pass unnoticed. For such a body very much work remains to do. The local distribution of British birds, insects, plants, &c., is by no means mapped out. Indeed in insects all the orders save the Lepidoptera, and to a smaller extent the Coleoptera, have been in this respect neglected.

The mysterious force named by the Hindûs "Akasa," or "Akassa," is said ("Psychological Review") to be identical with the Od of the late Baron Reichenbach.

The University of Würzburg, by occasion of its tercentenary jubilee, conferred the degree of "Doctor Philosophiæ Honorarius" upon Sir J. Lubbock and Prof. Huxley.

M. Certes ("Comptes Rendus") has observed and described an intestinal parasite in oysters from all localities, to which he has given the name *Trypanosoma Balbiani.* It approaches closely to *T. sanguinis* of Gruby, recently described by Prof. Ray Lankester under the name of *Undilina ramarum.*

Following upon the celebrated Huddersfield case of lead-poisoning through the public water-supply comes a somewhat similar affair at Keighley, which terminated fatally. A medical witness stated before the Coroner's jury that he had reported sixty-four cases of lead-poisoning to the municipal authorities about a year ago. It will be very serious if the use of pure waters has to be discontinued on account of their action on lead service-pipes. The circumstances under which water corrodes lead, and the possible means of prevention, require to be more closely investigated.

M. de Pietra-Santa ("Comptes Rendus") concludes that at Paris typhoid fever is most severe in the months of April and

November; that its distribution in the different arrondissements is unequal; that the number of deaths from this fever stand in no direct and constant relation with the population of the districts, their extent, the state of crowding, or the general mortality. It is impossible to ascribe to this disease a single cause, the "fœcal origin" of English sanitarians.

The "Darwin Prize" of the Midland Union of Natural-History Societies has been this year awarded to Prof. A. M. Marshall, D.Sc., M.D, for zoology.

Mr. F. B. Campbell, in a memoir read before the Linnean Society, shows reason for believing that parthenogenesis occurs among house-spiders,—a perfectly novel phenomenon, if established.

Herr E. Döll ("Verhandl. Kais. Kon. Geolog. Reichsanstalt") points out the existence of a zone of country in Hungary particularly affected by meteorites. Of the eight known cases recorded in the twenty-five years up to 1877, six fell in this region, and subsequently two more. In 1877 Dr. Lawrence Smith traced a local grouping of the North American meteorites.

A correspondent of the "Medical Press and Circular" speaks of the odour of the heliotrope as an efficient narcotic.

MM. Bokorny and Loew, of Munich, have forwarded to the Academy of Sciences a series of microscopic preparations demonstrating the differences between living and dead protoplasm.

According to "Ciel et Terre" four new planetoids have been recently discovered. Nos. 226, 228, and 229 were first seen at Vienna, by M. Palisa, on the 5th, 19th, and 22nd of August; whilst No. 227 was discovered on August 12th, by M. Henry, of the Observatory of Paris.

M. J. Vincent ("Ciel et Terre") records that in Belgium the average temperature of the month of August was lower than the average by 1·5° C. (=2·7° F.). The rainy days were twenty-four as against a mean of seventeen. The cloudiness has been 7·9 in place of the average of 6·2. Not a single day has been completely cloudless, and for two days the sky was entirely overcast.

Mr. F. F. Hilder ("Kansas Review of Science and Industry") controverts the conclusions of Dr. J. F. Snyder that the "Redskins found in North America by the first European explorers were "the people, or the immediate descendants of the people, who built the mounds." Mr. Hilder shows that the mound-builders must have had considerable mathematical knowledge; that they had fixed habitations and idols, of the origin of which the recent Indians confess themselves entirely ignorant.

Dr. C. Viguier ("Comptes Rendus de la Société de Geographie de Paris") ventures to suggest that there exists in man and in the higher animals an especial sensorial organ (where situate ?) for the perception of magnetic movements. This he considers is the faculty by which savages and animals are guided in unknown regions.

M. Dufour (Soc. Vaudoise des Sciences Naturelles) describes two remarkable hailstorms. One of these occurred on August 21st, 1881, in the Pays de Vaud, and was accompanied by a violent wind. The quantity of ice precipitated upon the Canton is estimated as at least a million cubic yards.

On July 13th, 1788, France, Belgium, and Holland were ravaged by a storm which discharged not less than 400 million cubic yards of ice. The cold produced was sufficient to cover the Lake of Geneva with ice to the depth of three-fourths of a yard. It is observed that well-wooded regions escape these visitations.

The Paris Company for the Utilisation of Solar Heat supplies portable " solar furnaces," likely to be very useful in tropical countries.

W. H. Ballon (" American Field ") communicates some interesting observations on the migrations of birds of prey in America. He gives a list of nine species which are true migrants, and of twelve species which migrate irregularly. All these migrations, the author considers, are based on a food-supply.

MM. Van Tieghem and Gaston Bonnier find that of a hundred peas preserved in the free air, ninety afterwards germinated ; of a hundred enclosed with air in a sealed tube, only forty-five ; whilst of a similar lot shut up in carbonic acid none proved fruitful. With other seeds the numbers varied, but the proportions were substantially the same.

According to a recent death-bed confession the splendid Mastodon at Albany is a forgery ! This is deplorable, as palæontological specimens generally will be viewed with suspicion.

M. de Comberousse, in a discourse pronounced at the funeral of the late Henri Giffard, made this significant admission :—"An intimate friend of Giffard told me yesterday that he carried to the tomb the secret which he had long sought for, and which had revealed itself to his eyes during his last years. He added that our colleague shrunk back from his own discovery, and, filled with horror, put an end to his existence." In other words he saw at length that aërial navigation must prove the suicide of civilisation.

A specimen of *Rafflesia Arnoldi* was in flower last month at the Berlin Botanical Gardens. The Berlinese boast that this establishment will soon surpass the Kew Gardens.

The swallows and the martins are said to have taken their departure from Paris at the end of August, instead of, as usual, about October 10th.

M. Hennessy ("Comptes Rendus") argues that the mean temperature of the Northern Hemisphere is not higher than that of the Southern.

According to Tieghem certain low plants—Ascomicetes, Mucorini, &c.—live and increase in oils in the absence of atmospheric air.

The "Deutsch-Amerikanishe Apotheker Zeitung" replies to a correspondent that "between cruelty to animals and vivisection, in the scientific sense of the term, there is a mighty difference, which many persons have not recognised and cannot recognise."

According to Prof. Xavier Landerer, of Athens, rabies is exceedingly common in the East among dogs, cats, and jackals. This observation overturns the theory that the disease is produced by confinement, chaining, muzzling, &c.

The so-called double or twin canals which have become visible on the surface of the planet Mars are occasioning much attention.

Prof. Freeman, of the Johns Hopkins University, of Baltimore, concludes, from a long series of experiments, that electricity is not demonstrably disengaged by the evaporation of fluids.

The subterranean chambers of the Observatory of Paris are about to be utilised for studying the changes which the attraction of the heavenly bodies may occasion in the reflecting surface of a bath of mercury.

Statues are about to be erected at Besançons and Beaume les Dames in honour of Claude de Jouffroy, who is now alleged to have been the originator of steam-navigation.

M. P. de Tchihatcheff, in a paper read at the recent Southampton Meeting, contends that the great deserts of Africa and Asia are not sea-beds, recently laid dry, but they have been upraised at remote geological epochs, and that their sand is not of marine origin, but is the product of rocks disaggregated by winds, changes of temperature, &c. He admits that the Asiatic deserts are much more ancient than the Sahara. At a point in the Gobi, of the same latitude as Palermo, Russian explorers found, as late as May 16th, a temperature of 22° F., and snow 2 yards in depth!

M. d'Abbadie ("Comptes Rendus") recommends fumigations of sulphur as a preservative against the effects of malaria. He gives an interesting account of the gradual ruin of Zephyria, in the island of Milo, a town once containing 40,000 inhabitants, which became depopulated by fevers as soon as the sulphur-works were removed from its neighbourhood to the other side of the island.

"*The Cause of the Stratification of the Flints of the Upper Chalk.*—It has long been considered that the beds of flint in the upper chalk are the silicified casts of sponges, but opinions differ concerning the force that placed them in beds ; and while modern books on geology mention enormous heat, chemical precipitation, and other old theories as the causes of their stratification, they at the same time give little credence to them. Now, it seems to me that in the habits of sponges themselves, and in the nature of the formation of the chalk in which they exist, is to be found a quite sufficient reason of their stratification. The mode of reproduction in sponges is for one of the inhabitants (embryos) to detach itself from the community and float away until it arrives at a place suitable for the formation of a colony, which it then establishes, and which, after a time, in its turn comes to maturity and sends forth its citizens with the object of fresh colonisation. Now, it is agreed on all hands that at the time living sponges existed in the chalk that substance presented precisely all the physical and chemical conditions of the Atlantic ooze, and this to such a degree that the same shells (Globigerina) that are most abundant in the one are most plentiful in the other.

"Science has shown beyond doubt that the Atlantic ooze is formed by a constant rain of these discarded shells falling from the water to the bottom.

"These facts explain the stratification of flints. We will imagine a single sponge at the bottom of the chalk sea. It thrives and sends out colonists, which have not far to go, as the land surrounding the old city is unoccupied. Consequently six new cities are ranged round the old one, and thrive and grow to prosperity. During this time the rain of chalk has been constantly falling, but the deposit has been greater on the old and central city than on the colonies, because it has existed longer. The six sponge cities then desire to colonise. They send out embryos, which obviously cannot form colonies in the direction of the old original sponge, but start in the direction of the as yet unoccupied ground, forming fresh colonies, which become cities, and in turn commence colonisation. Thus the original sponge grows into a circular patch of sponges, which after a length of time, in consequence of the falling of the chalk rain, must become a ring of life whose vitality is greater at the outer edge, and which gradually fades into death towards the inner as the central sponges become choked and covered by the shell rain, and are too far from the enegetic and external ring of life to be directly colonised therefrom.

"As any sporule starting from a healthy sponge on the outer edge of this ring would find in one direction an open field for colonisation, and immediately behind it nothing but compact masses of life, and even if it should sail by accident far back over the healthy inhabitants, it would in all probability only come to those suffering more and more from suffocation and decomposition the farther it went (but even should it so happen at any time that it should travel so far towards the centre of the circle as to reach a place where its ancestors had been completely buried and start there a colony, it would only perform over again what the first sponge had done and what I have attempted to describe, and so form the second layer of sponges); therefore it must naturally develop in the direction of the unencumbered surface.

"Thus this ring of life would pass over the bottom of the sea, to be followed by another ring from another source, after an epoch of uninterrupted chalk deposition, or may be the same life would return after a tour in other seas.

"Thus it is possible that, in the past and the future, wave after wave of sponge life may pass over the ocean floors whose existence may be registered in stone by the separation of the small quantity of silica contained in the nacre of the Foraminifera.—A. ANTHONY NESBIT."

(In borrowing the above notice from our contemporary, "Land and Water," we wish to bespeak for it the attention of our geological readers.—ED. J. S.)

ERRATUM.—Page 553, line 22, *for* "adult" *read* "earlier."

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THE

JOURNAL OF SCIENCE.

NOVEMBER, 1882.

I. RECENT STUDIES IN COMPARATIVE PSYCHOLOGY.*

IT is well known that common convention refers the actions of animals other than man to "instinct." What this same "instinct" is, how it operates, how it is to be distinguished from reason, are indeed questions which few persons even attempt to answer, and concerning which scarcely two of these few are agreed. For all this we find the notion obstinately upheld by literary men, lawyers, poets, metaphysicians, and the like—the more obstinately in general the less they have been accustomed to a close and heedful study of animal life. Actual working naturalists, on the other hand, such as have made a point to observe "our poor relations" in the woods, the fields, or, in default and supplementation, in the vivarium or the aviary, almost invariably come to a very different conclusion. They find this phantom "instinct"—in the common acceptation of the term—receding as they approach it, and are driven to admit that animals possess and are guided by faculties like our own in kind, though for the most part of much lower degree. Strange to say, however, the conclusion thus forced upon the naturalist exposes him, if expressed in speaking or in writing, to some little unpopularity. The irrationality of brutes is commonly assumed to be in some mysterious manner a tenet of the Christian faith, and he who shows that they are capable of tracing analogies, of arguing from effect to cause, and of recognising an "order of Nature," not seldom finds himself dubbed a "sceptic," a "free-thinker," or at least pronounced "unsound."

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* Animal Intelligence. By G. J. ROMANES, F.R.S. London: Kegan Paul, Trench, and Co.

We said that concerning the nature of this "instinct" we are as little agreed as were our forefathers a hundred years ago anent the attributes and the functions of phlogiston. The great bulk of non-naturalists—we might almost venture to call them *un*naturalists—hold that instinct, whilst performing to some extent the same functions as those which in us devolve upon reason, and being thus its substitute, is yet a power or faculty of a totally different order. There are thinkers, including a most eminent biologist of Evolutionist principles, who assert that animals remember places, persons, events, &c., not by dint of memory, but of "*quasi*-memory"; that, in like manner, they decide on expedients to be adopted in some emergency, not in virtue of intelligence, but of "*quasi*-intelligence." It may well be asked whether, in thus multiplying imaginary faculties, they are not sinning against Newton's celebrated *regula philosophandi.* A writer in the "Journal of Science" has pointed out that we might as well ascribe the fall of solid bodies upon the moon to "*quasi*-gravitation."

Others, whilst admitting that the actions of animals are mainly instinctive, consider that they are "very commonly tempered with a little dose of judgment or reason."

In the work before us we find an approximate definition of instinct to which little valid objection can be taken. Mr. Romanes regards it as "mental action (whether in animals or human beings) directed towards the accomplishment of adaptive movement antecedent to individual experience, without necessary knowledge of the relation between the means employed and the ends attained, but similarly performed under appropriate circumstances by all the individuals of the same species." We are far from denying that mental action, of the character here laid down, occurs both in man and beast. The conduct of the solitary mason-wasp, or carpenter-bee, in building her nest must clearly be classed as instinctive, thus regarded. She has had no individual experience; the nest is her first effort, and she never survives to construct another. She has had no instruction, since she never saw her parents, who must have perished before she issued from the egg. Her mate and any other of her own species whom she may have seen are exactly in the same position as herself. Hence we need feel little surprise if early observers, who did not and could not enter into the genesis of these powers and aptitudes, saw in them the workings of some especial unitary faculty, standing in the stead of reason.

But the definition of "instinct" tacitly held by the outside public, and by those whom we may call naturalists of the Old School, is something different from that quoted above. They pronounce it a divinely implanted faculty given to the lower animals instead of understanding. Hence they by implication, at least, denied its presence in man. Now if "instinct" were a divinely implanted faculty, we may safely assume that it would never prove mistaken and misleading. Yet such errors have been observed from the time when Gilbert White described the martins building their nests in the angles of a window too shallow to afford due support to the structure, to the more recent case where Mr. Wallace saw *Rhyncophorus* beetles boring into gummy wood and being held fast by the glutinous fluid.

The believers in "instinct" as a something exclusive of reason will, if they carefully examine the question, find themselves surrounded with difficulties. If they incline to the unitary or monistic view of Nature, they must regard both reason and "instinct"—or, if they prefer the term, "*quasi*-intelligence"—as functions of the brain. But if we take structures so nearly alike as the brains respectively of the higher apes and of man, we may well ask—How can the functions of these organs differ not merely in degree, but in kind? If they suppose—as we believe some do—that the mind of man is a spiritual principle, whilst brutes are totally material, we crave to know how "mere matter" can in the ape perform actions so closely resembling those which in man require the co-operation of matter and spirit? To say that this similarity is divinely ordained is to assume the existence of a "*Deus quidem deceptor*," just as was involved in the old notion of fossils being not the remains of animals once existing, but objects specially created. If, again, we assume that the intelligence of man and the "*quasi*-intelligence" of the ape are both in their essence spiritual, we have then two immaterial principles using tools (*i.e.*, the brain) very similar, producing results very similar, and yet differing not in grade merely, but *toto cœlo*. We would commend these questions to the consideration of thinkers.

But if we consider instinct in man or beast to be merely hereditary aptitude, called into play by appropriate circumstances, the difficulties of the case vanish so rapidly that we may expect their entire disappearance at an early date. We see, in fact, new instincts being created in this manner. On this point the well-known case of young pointer dogs is decisive. Such a dog may never have seen his parents point at birds, and may never have received any training from man; yet when brought for the first time into a stubble field he acts as if he had received such instruction. This case is the more important since it shows us not merely the growth of an instinct by hereditary transmission, but the extinction of a prior instinct of all dogs—that of rushing at any birds or small beasts which make their appearance. Why need we then affect to wonder at the nest-building of a bird or insect? We may even fairly contend that in a creature entirely devoid of intelligence these instincts could never have arisen.

Mr. Romanes, in the work before us, takes the animal kingdom in review from the lowest to the highest forms, and traces everywhere a something which to candid readers must appear to differ from the human mind merely in degree. Of course it is open to the advocates of the old way of regarding the actions of animals to pronounce the capital instances brought forward exaggerations, mis-observations, or even pure inventions. Such a plea is somewhat curious when urged by persons who in other respects are not free from credulity, and who as a body have rarely, if ever, devoted themselves to a close and prolonged study of the habits of animals. They urge that if birds and beasts were rational we should find proofs thereof in their general conduct. But uniform rationality cannot be traced in the actions of mankind: how, then, can we fairly expect to trace it in the doings of the ape or the dog?

The first case given by Mr. Romanes brings into prominence a principle of no small importance. According to a passage quoted from an unpublished MS. of the late Charles Darwin, "Even the headless oyster seems to profit by experience. Dicquemase ("Journal de Physique," xxviii., p. 244) records that oysters taken from a depth never uncovered by the sea open their shells, lose the water within, and perish; but oysters taken from the same place and depth, if kept in reservoirs where they are occasionally left uncovered for a short time, and are otherwise incommoded, learn to keep their shells shut, and then live for a much longer time when taken out of the water." According to Bingley ("Animal Biography," vol. iii., p. 454) this fact is turned to practical account in the "oyster-schools" of France:—"The distance from the coast to Paris being too great for the newly-dredged oysters to travel without opening their shells, they are first taught in the schools to bear a longer exposure to the air without gaping, and when their education is complete they are sent on to the metropolis, where they arrive with closed shells and in a healthy condition." This simple fact proves that even animals so low in the scale of organisation can modify their actions according to circumstances so as to avoid inconvenience. No possible array of vain words, no hair-splitting, however subtle, can blind us to the truth that we have here intelligence. That an animal to be capable of training must possess intelligence is, indeed, self-evident.

Turning to insects, we find among the ants mental powers of a much higher grade. The evidence that they possess memory is superabundantly complete. Nor do we see by what right their power of remembering, *e.g.*, members of their own community, after prolonged absence, can be called "*quasi*-memory," or can be in any way differentiated from the faculty of memory in ourselves. It is well known that a strange ant, even of the same species, if introduced into a nest, is at once, as a rule, attacked and killed without mercy. But if some of the inmates of a nest are removed, and kept apart from their fellows even for months, they are at once recognised when brought back to the community. It is an important fact that this recognition is not "automatically invariable." "When ants are removed from a nest in the pupa state, tended by strangers, and then restored, some at least of their relatives are certainly puzzled, and in many cases doubt their claim to citizenship. I say some, because, while strangers under the circumstances would have been immediately attacked, these ants were in every case amicably received by the majority of the colony, and it was sometimes several hours before they came across one who did not recognise them."

As to the memory of ants for direction and locality, many of the observations on record are open to doubt on the score that the re-discovery, *e.g.*, of an abandoned nest, as in the case mentioned by Belt, may be accidental. But Karl Vogt, in his "Thierstaaten," mentions that "for several successive years ants from a certain nest used to go through several inhabited nests to a chemist's shop 600 yards distant, in order to obtain access to a vessel filled with syrup." Mr. Romanes adds the very just comment—"As it cannot be supposed that this nest was found in successive working seasons by as many successive accidents, it can only be concluded that the ants remembered the syrup store from season to season."

As regards the power of communication possessed by ants the following experiment, performed by Sir J. Lubbock, is adduced:—Three glasses were connected with a nest of *Formica niger* by means of three tapes, equal in length and width, and placed parallel with each other, so that the means of access from the nest to each glass were exactly equal. In one of the glasses were placed from 300 to 600 larvæ, in the second two or three only, and in the third none at all. The object of the last was to see whether any ants would arrive at the glasses by mere accident. The experimentalist then put a mature ant into each glass. Each of them took a larva and carried it to the nest, returning for another, and so on. After each journey another larva was put in the glass containing only few larvæ. Sir J. Lubbock reasoned that if ants came to the glasses as a matter of accident, or accompanied one another by chance, or if they merely saw larvæ being brought and concluded that more might be found in the same place, or if the ants were merely guided by the scented track of their forerunners, the number of the ants going to each of the two glasses ought to be approximately equal. But this was not the case. To the glass containing many larvæ there came, in 47½ hours, 257 ants; to that with only two or three larvæ there came, in a time longer by 5½ hours, only 82 ants; and to the glass containing no larvæ there came not one. Hence it is concluded that ants cannot merely tell their companions that there is work to be done, but can give some idea of its quantity, and of the number of hands required for its performance. The precautions taken by Sir J. Lubbock will, on careful consideration, be found to exclude every other interpretation of the facts.

Mr. Romanes also gives certain facts proving that ants can take note of difficulties and dangers, and devise methods how such may be avoided or overcome. They have, indeed, the power of invention. The following incident is quoted from the well-known work of Belt:—"A nest was made near one of our tramways, and to get to the trees the ants had to cross the rails over which the waggons were continually passing and repassing. Every time they came along a number of ants were crushed to death. They persevered in crossing for some time, but at last set to work and tunnelled underneath each rail. One day, when the waggons were not running, I stopped up the tunnels with stones; but although great numbers carrying leaves were thus cut off from the nest, they would not cross the rails, but set to work making fresh tunnels underneath them."

Prof. Leuckart, it is stated, "placed round the trunk of a tree which was visited by ants, as pasture for Aphides, a broad cloth soaked in tobacco-water. When the ants, returning home down the trunk of the tree, arrived at the soaked cloth, they turned round, went up the tree again to some of the overhanging branches, and allowed themselves to drop clear of the obnoxious barrier. On the other hand, the ants which desired to mount the tree first examined the nature of the barrier, then turned back and procured from a distance little pellets of earth, which they carried in their jaws and deposited one after another upon the tobacco-cloth till a road of earth was made across it, over which the ants passed to and fro with impunity."

A very similar observation was made more than a century ago by Cardinal Fleury, and published by Réaumur:—"The Cardinal smeared the trunk of a tree with bird-lime, in order to prevent the ants from ascending it; but the insects overcame the obstacle by making a road of earth, small stones, &c., as in the case just mentioned. In another instance the Cardinal saw a number of ants make a bridge across a vessel of water surrounding the bottom of an orange-tree tub. They did so by conveying a number of little pieces of wood." These instances, with others that might be either quoted from Mr. Romanes or adduced from other trustworthy sources, prove that ants have the power of invention.

Over a great part of the work before us, as well as the reflections which it cannot fail to suggest, we must pass rapidly. But we are bound to note certain observations showing how rapidly birds in a wild state learn from experience. Mr. Holden found that when telegraph-wires were first set up along the road from Larne to Cushendall, on the coast of the county Antrim, numbers of starlings were found lying dead or wounded on the roadside, they having evidently in their flight in the dusky morn struck against the telegraph-wires. Through the following and the succeeding winters hardly a death occurred among the starlings on their arrival. "It would thus appear that the birds understood the cause of the fatal accidents among their fellow-travellers the previous year, and hence carefully avoided the telegraph-wires; not only so, but the young birds must also have acquired this knowledge and perpetuated it."

Touching the readiness with which birds appreciate a new danger, real or apparent, we were once informed by an old gardener at Aylesbury that a scarecrow is rarely effective for more than three days. At the end of that time the birds have come to the conclusion that it is a mere *brutum fulmen*, and a fresh device is needful.

According to Mr. Thomas Guring the geese kept on the common outside a small market-town came regularly into the principal street, early in the morning after the fortnightly market-day, to pick up the corn which was scattered from the sample bags. It might be suggested that they were made aware of the market-day by the unusual bustle on the roads, or that they were attracted by the smell of the corn. Accident supplied the *experimentum crucis.* A day of national humiliation was appointed on the day when the market would have been held in the ordinary course of things. There was no traffic on the roads, and no corn to be scented; yet the geese made their usual appearance the next morning. This fact proves that these "stupid" birds can mark intervals of time.

Mr. H. L. Jenkins, speaking of the elephant, states in a private communication to the author:—"There are good reasons for supposing that elephants possess abstract ideas; for instance, I think it is impossible to doubt that they acquire, through their own experience, notions of hardness and weight. The grounds on which I am led to think thus are as follows: a captured elephant, after he has been taught his ordinary duty, is taught to pick up things from the ground and give them to his mahout sitting upon his shoulders. For the first few months it is dangerous to require him to pick up anything but soft articles, because the things are often handed up with considerable force. After a time they appear to take in a knowledge of the nature of the things they are required to lift, and the bundle of clothes will be thrown up sharply as before, but heavy things—such as a crowbar or a piece of iron chain—will be handed up in a gentle manner; a sharp knife will be picked up by its handle, and placed on the elephant's head, so that the mahout can also take it by the handle. I have purposely given elephants things to lift which they could never have seen before, and they were all handled in such a manner as to convince me that they recognised such qualities as hardness, sharpness, and weight."

Mr. Peal observed a young recently-captured elephant, in Assam, pulling up and breaking some bamboo stakes, and carefully examining the pieces. "At last it seized one firmly in its trunk, and, advancing its left fore leg, passed the fragment of bamboo under the arm-pit, and began to scratch with some force. A large elephant leech soon fell to the ground, which, from its position, could not easily be detached without this scraper which had been deliberately made by the elephant." The narrator very truly says that these scrapers are *boná fide* tools, "intelligently made for a definite purpose." Man, we see, is not the only tool-using animal.

Sir E. Tennent, in his "Natural History of Ceylon," gives an account of a wild rogue elephant which had driven two men up a tree. "After vainly attempting to pull up or overturn the tree, observing a pile of timber at a short distance, he brought it all (thirty-six logs), one at a time, to the root of the tree, and piled them up in a regular business-like manner; then placing his hind feet on this pile, he raised the fore-part of his body and reached out his trunk, but still could not touch us." We have here, surely, a rationally conducted siege!

In the section on the domestic cat a capital case is given on the authority of Mr. James Hutchings, of Banbury. "An old tom cat used a young bird, which had fallen out of its nest, as a decoy for the old birds. The cat touched the young bird with his paw when it ceased to flutter and cry, in order that by thus making it display its terror the old cock bird—which was all the time flying about in great consternation—might be induced to approach near enough to be caught. Many times the cock bird did so, and the cat made numerous attempts to catch it, but without success. All the while a kitten had to be kept from killing the young bird." Here we have a stratagem devised for effecting a definite purpose. That stratagem could only have struck a being who had observed and remembered that birds will run unusual risks in the defence of their young. But on careful examination we find here something further. Why did the cat not at once devour the young bird? Because he hoped to employ it as a means for entrapping a more valuable booty—one of the parents. Here, then, we find an instance of an animal repressing its natural instincts, and foregoing a present advantage in order to secure some greater benefit hereafter.

Prof. Mivart ("The Cat," p. 373) enumerates certain "human mental powers, of the possession of which by the cat no evidence exists." Among these figures "A power of, on certain occasions, deliberately electing to act (or to abstain from acting) either with or in opposition to the resultant of involuntary attractions and repulsions — will." Here, then, we have distinct evidence of such "will."

Mr. Romanes represents Arago as having observed the case of a turnspit which refused to make the spit revolve when it was his companion's turn to work. The eye-witness of the incident, if we mistake not, was Ampère, and Arago merely mentions it in his official *éloge* of his deceased friend.

But the incident is a full proof that brutes possess a sense of justice.

A Mr. W. H. Bodley gives an incident which throws a curious light upon the inner life of dogs. He writes concerning a retriever :—" Before he came to me he lived where another dog of similar size was kept, and on one occasion they fought. Having been chastised for this, on future occasions when they quarrelled they used to swim over a river of some breadth, where they could not be interfered with, and fight out their quarrel on the other side. What seems to me noteworthy in this conduct is the *self-restraint* manifested under the influence of *passion*."

Several instances are given of dogs recognising the portraits of their masters,—a faculty which has been denied by writers of the Old School.

Mr. Romanes, as we learn with interest and satisfaction, considers that "the mental life of the Simiadæ is of a distinctly different type from that of the lower animals, and that in their psychology, as in their anatomy, they approach most nearly to *Homo sapiens*." He points out, further, that these animals have never enjoyed the improving influence of hereditary domestication, and regrets that our knowledge of the psychology of the anthropoid apes is exceedingly imperfect. One of the most important parts of the entire work is a full account of observations made on a brown capuchin (*Cebus fatuellus*) which the author had in his house during the winter of 1880-81. Some of the points elicited are exceedingly valuable. The power of monkeys to throw objects at an enemy, and that with great force and precision, is fully established. The monkey in question having got possession of a hearth-brush, unscrewed the handle, and after much study succeeded in screwing it in again. He practised this new accomplishment for some time, and then threw the brush aside. "The desire to accomplish a chosen task seems a sufficient inducement to lead him to take any amount of trouble. This seems a very human feeling, such as is not shown, I believe, by any other animal."

We must here close our brief and fragmentary survey of a work for which we must bespeak the earnest attention of all naturalists. They will find, we think, full proof that the lower animals possess real, and not merely "*quasi*," intelligence. At the same time no one can deny that the subject has been hitherto only "scratched" on the surface, and that much additional study is needed.

II. CRAM AND ITS AMENITIES.

By Frank Fernseed.

At the risk of hurting, perhaps, the feelings of such of my readers as are well pleased with the peculiar features of the English system of education, I cannot help calling attention to some recent and alarming revelations. Brain-work, it must be conceded, is not *per se* physically injurious. On the contrary, when kept within reasonable bounds and right conditions, it appears distinctly favourable to health and long life. Wœhler has just departed from us at the age of 82; Dumas is a few days older. Chevreul, accidents excepted, promises fair to become a centenarian. Darwin, though shattered by the fearful seasickness which haunted him during the whole of the memorable voyage of the *Beagle*, yet exceeded the proverbial three score and ten years of human life, and was able to carry on his investigations to within twenty-four hours of his death.

But what are the conditions under which brain-work is safe and salutary? Firstly, the brain, like every organ, must be sufficiently mature before it is subject to much exertion. Being probably the latest of all our organs to reach its full vigour, it cannot be prematurely tasked—I will not say overtasked—without injury to it and to the whole system. It is strange that we can grant the unwisdom of working the muscles, tendons, and bones of a horse before they are sufficiently developed, and yet not hesitate to make a premature demand upon the main nervous centre of our children. But a "sanitary reform" in this direction agrees ill with that industrial organisation of society which, according to some thinkers, is the ultimate goal of human progress.

The second great condition under which study is wholesome is freedom from anxiety, hurry, and worry. This condition is admirably illustrated in the career of almost all great investigators of Nature. Wœhler, for instance, contributed no fewer than two hundred and twenty-five memoirs to the scientific journals or to the Transactions of learned societies. Almost all of these papers are of great value, and many of them embody the outcome of months of careful and delicate experimentation. But in no one case was he compelled to finish any of these researches at a certain date under appropriate pains and penalties. Precisely the same was the case with Darwin: he was able to pursue his inquiries calmly and dispassionately,—able always to take two or three years if his task could not be finished in one, and in no fear of any unpleasant consequences if some idea which he had taken up should lead to nothing.

But if we say to a man, to a youth, or worse still to a child, "You must by a given date reach a certain standard of knowledge, a certain grade of culture, to be judged of in a very summary way, or in default you shall be cut off from the means of earning a livelihood," we place him in the very conditions wherein study becomes unsanitary, even ruinous, and that the more decidedly the more immature the brain. Yet so long as our national system (?) of education is allowed to turn upon preparing for and "passing" examinations, children at our elementary schools, youths seeking admission into the Civil Service, and young men qualifying themselves for the professions, are kept in peril of having their intellects permanently stunted and enfeebled, and their general health injured. At the risk of digressing from my more immediate subject I will here say that the true method for testing the proficiency of a student should be not catastrophic, but, like the great processes of Nature, continuous, "*stetig*."

To return: these evil consequences of hurried, forced work, under the spur of anxiety, are not mere suppositions as to what may be; they are, and have been, actually observed. We may take first the case of children in our primary schools. Mr. Colt-Williams, in his Official Report to the Committee of Council on Education, on the schools which he had examined last year in the counties of Radnor and Hereford, calls especial attention to the overworking of the young pupils, and says, with an especial reference to the proposed extension of the curriculum:—

"All this extra work means extra hours of study with less play, and children do not get too much play now. When one thinks of children of tender years coming in all weathers one and a half or two miles to school to be there by nine in the morning; school till twelve; play and dinner—and how scanty that dinner often is—till two p.m.; school again till four or 4.30 p.m., and then the walk home, in winter often in the dark, home lessons to prepare for next morning, and this for five days in the week for more than nine months in the year; can more be added? And yet this is the daily routine of schools in my district, though we have no singing by note, very little poetry,—that only in Standards 4, 5, and 6,—and no Science. Time will show whether soundness in elementary subjects will not give way to the smattering of a medley. As it is, I have heard more than once of children passing sleepless nights, and muttering their sums in their dreams. Can such overwork of young brains be a good thing? and is not the proper development of thews and sinews, of muscles and lung power, of greater importance than an aimless murdering of the gems of Shakspeare and Milton? It may seem a bold thing to say, but I can only express my belief that if the present curriculum be extended, and there is consequently a curtailment of recreation, the physical vigour of our country lads and lasses will deteriorate—a serious question when the needs of Army, Navy, and husbandry are considered."

On this significant passage I must remark that play for a child is not a mere luxury which may be cut off at pleasure. It is an essential part of his education, and vastly more important for his future well-being than any amount of literary culture.

No one who has any acquaintance with physiology—a discipline with which the Committee of Council on Education have doubtless not been much troubled—can fail to catch the sad meaning of the "sleepless nights" and "mutterings in dreams" which are here recorded. The sleep of healthy childhood is deep, and often entirely dreamless. Such symptoms when they occur prove but too plainly a serious disturbance of the nervous system. We talk of "payment by results." Are we to include and pay for constitutions undermined and intelligence weakened?

It must also never be forgotten that physical vigour is important, not merely for the Army, the Navy, and for husbandry, but in every calling and every sphere of life. It is time we cast aside the ideals of mediæval asceticism, the emaciated frames, the flabby muscles, the drooping necks, which were supposed to indicate the triumph of mind over matter. We must return to the healthier notions of classical antiquity, and admit that bodily vigour is the essential groundwork for intense mental activity.

It was once proposed by a peer of the realm, formerly, if I mistake not, a successful university coach, and who may therefore not uncharitably be supposed to retain a certain kindness for "cram," that all children should be forced by the time they reached a certain age to "pass" certain "standards." On the feasibility of this suggestion the following facts may throw some light:—Two boys, the sons of a man who had been for more than two years out of employment, attended a certain school. Like all their family, they appeared to be very inadequately fed, and for two years they made no progress at all. Without any obstinacy or indisposition to learn they seemed unable alike to comprehend and to remember. At last the father obtained employment, the boys were fairly fed, and at once a total change came on. In the next three months they made far more progress than they had done during the foregoing two years. What, in face of such a fact, can be said of the proposal to force children of a given age up to a fixed standard? The under-fed are, I fear, very many, both in town and country; and there are other physical causes which may render some children less able to learn than others. If ever we succeed in obtaining a responsible Minister for Education in place of the Committee of Council, I trust he may be always a physician. It is a fearful thing to let the brains of a nation be played with by men ignorant and careless of their structure, their development, and their functions.

But we must beware of supposing that the evil physical results of our English system of education end with the primary schools. The striplings and young men who are tormented with competitive examinations have brains more mature than have the children of whom we have just been speaking, but in compensation they are more keenly alive to the consequences of the ordeal they are about to face,—an ordeal which, testing stringently verbal memory, glibness of speech, and cool assurance, does not and cannot test originality of thought, suggestiveness, and fertility in resources. These unfortunate young men know what to them will be the result of failure, and they suffer accordingly. Says the "Lancet": "The competitive system as applied to youths has produced a most ruinous effect on the mental constitution which this generation has to hand down to the next and particularly the next but one ensuing. The work of the Civil Service Commissioners is individually and racially destructive."

Is this, again, mere supposition? I have heard of a batch of successful candidates for the Indian Civil Service being before receiving appointments submitted to medical scrutiny, with the result that several were found suffering from albuminuria,—the result of the strain which had been put upon them. I hear on all hands of young men who have "gone up" for examinations, breaking down in health afterwards whether successful or unsuccessful. And who that is brought in contact with our "competition wallahs" at Somerset House or elsewhere can fail to note the want of life and energy which these unfortunates exhibit in every look, tone, and movement? Surely the price which the nation is paying for the abolition of "influence and favouritism" is too ruinously dear!

It is a common subterfuge with the defenders of the English system of education with its everlasting prizes and certificates, when pressed on the points just mentioned, to say: "Examinations are a poor test, but we cannot devise a better." It is therefore with peculiar satisfaction that I notice certain revelations which have lately been brought to light, calculated greatly to shake the confidence of the public in this supposed test. The disclosures in question occurred in Dublin, and relate primarily to medical education. But in their essence they apply to the courses of study required for all professions and for all positions where a certain standard of attainments is demanded. Within the last twenty years there have sprung up a class of persons technically known as "coaches," "grinders," &c. These persons make it their special business to "prepare" students and candidates for any and every examination which they may require to pass. At first sight it would of course seem to the uninitiated that such a "coach" must have some happy and secret knack of conveying to his pupils a sound acquaintance with the various branches of science or literature in which they are liable to be examined. On further thought it will appear strange that one and the same man, with perhaps a couple of assistants, should be able to teach a multitude of different subjects better than can a body of professors, each of whom has made one science the study of his life. On further prying, the inquirer will find that the duty and the aim of a coach is to teach, not so much any science, as the art of passing an examination in such science. By his success or failure in communicating this art he must stand or fall. Accordingly he studies closely and carefully, not the subjects, but the examiners. He obtains lists of the questions asked year by year, and these he collates and submits to a close analysis. Some questions he finds recur very frequently, and for these he accordingly specially prepares his pupils. Others, he finds, are very rarely put, and these he considers may be safely neglected. A gentleman of this class said recently in evidence: "I closely watch the whole business. I have two things to find out—first the questions, and next the answers. As regards the questions, I examine the man's previous papers very closely. I exclude the questions which have recently been asked. . . . There is one respected gentleman, who happens to be alive, and his number of questions is something under 50. He repeats these questions; that is to say, he takes a section of those 50 questions each time."

Hence it will easily be seen that any candidate about to be examined by this gentleman must, however much or however little he may know of the subject in general, be prepared with the answers to these fifty questions. But the judicious coach can make a still closer approximation to the mark, and still further narrow the ground upon which his pupils have to concentrate their attention. Most examinations are twofold, partly in writing and partly oral. The coach just quoted has observed that: "The written questions are used for the *vivâ voce* at the next examination, and *vice versâ*. Examiners have an enormous inclination towards that. If I hear that a man has given (certain questions) *vivâ voce* on any given occasion, those questions are very carefully considered for his next paper. I am pretty sure that in his subsequent (verbal) examination he starts with a few fresh subjects, and that when he is tired, towards the end of the day, he will have got over his first selection, and he will think of what he will ask, and the probability is that he will drop on to the last examination paper, because he has considered it carefully and brooded over the answers."

So much for the "positive method" by which the coach ascertains approximately what any given examiner is likely to ask. But the examiners have other idiosyncracies in addition to the mere repetition or non-repetition of questions, and these, also, the coach notes and takes into account. Thus, one examiner may have a fondness for theories, whilst another, on the same subject, adheres more to facts. Everyone has his special predilections for certain phases of his subject, upon which he, consciously or not, insists. What, for instance, would be the fate of a student in chemistry who presented himself for examination at South Kensington without an extensive knowledge of graphic formulæ? Were he as deeply versed in the philosophy of the science as Mendelejeff, did he rival Fresenius in analytical skill, and vie with Baeyer in the power of effecting organic syntheses, still, lacking this wedding garment, he would be ignominiously cast out.

So much, then, for the "positive method," by which it is calculated what an examiner will probably ask. I turn now to the complementary stratagem, known as the "negative method," by which it can be approximately ascertained what the examiner will not ask. This method, says the same coach, is "by no means equally applicable. There is one gentleman whose examinations have extended over sixteen years. I have a *précis* of fourteen years of his examinations, and the total of his repetitions is under a dozen. I speak in this case of printed papers." In other words, during fourteen years only twelve instances have occurred where a question once asked has been repeated. Hence the coach declares himself "perfectly safe" in excluding those subjects from the preparation of his pupils.

It cannot for a moment be doubted that a student—if we may so call him—thus trained has an enormous advantage over one who has simply obtained the best possible knowledge of the entire subject. The former has merely to grapple with certain select portions of the science in question, whilst the latter must go over the entire ground. Hence, we need not wonder that "all but the very poorest students" have recourse to these private teachers. We see here, also, the full meaning of those memorable words of Professor Huxley,—"We pass and do not know." Is it not time that the public, therefore, should begin to pay less honour to men who have passed, and to seek out, by their performances, men who know? I may seem prejudiced, but had I any appointment to bestow, my first stipulation would be, "no one who has prepared for any examination need apply!"

III. ON THE "RIGID EARTH" PARADOX.

By E. L. Garbett.

A NOTION seems to be abroad that the mathematical exercises of Professors Sir W. Thomson and G. Darwin, on a "rigid" or a "viscous" planet, apply somehow to the actual Earth, and prove some rigidity in her; or even, according to Mr. Proctor ("Knowledge," p. 258), "conclusively dispose of the theory that the Earth is a mere crust, 40 or 50 miles thick, and full of molten lava." Now I submit that he might, without following a line of their calculations, have gathered from their mere statements of results, that these belong only to imaginary globes, and prove no more about the Earth of Nature than do Hampden's ingenious maps on the *flat* theory "dispose of the theory" that she is a globe.

The beginning, so far as I know, of this "rigid" paradox, was a mistake of Sir W. Thomson's, which Sir Edmund Beckett copied into *one* edition of his capital "Astronomy without Mathematics;" that the rate of precession would not be the same in a fluid earth as in a rigid one, and that the actual rate (commonly explained on the assumption of an unyielding solid ball) would not apply to a perfect fluid. Now in the "Philosophical Transactions" for 1880 (p. 464) we find this entirely retracted. Prof. Darwin there italicises, as both his own result and Sir W. Thomson's, that "*The precession of a fluid spheroid is the same as that of a rigid one which has an ellipticity equal to*" the fluid one's. But meanwhile, as they were correcting this slip, an exactly similar one was made about the tides. These are commonly explained on the same easy idea of a rigid ball covered with sea; and everyone may readily infer (though they would be quite wrong) that, if the Earth's interior be as fluid as the sea, both would be deformed alike, and thus, every spot of sea-surface preserving its distance above the bed unchanged, there would be no marine tide. They would err, because it is a thing "not generally known" that the school-book diagrams all exactly reverse, as regards high and low water, the real effects in a general ocean as shallow as our actual ones. The Moon's (or Sun's) pull *direct*, that would, as they show, heap the waters under the pulling body, and pull the Earth from the further sea surface, would thus act were the ocean thousands of miles deep; but as it is only 2 or 3 miles, this effect is vastly excelled and quite masked by another, namely, that the eastward rotary movement, common to the ground and waters, is *retarded* by the moon wherever they are going *from* her meridian, but *accelerated* where they are returning *to* it,—*i.e.*, retarded during the six hours before moonrise or moonset, and accelerated during the six after those events. This heaps them up at moonrise and moonset, making—were the ocean universal and frictionless—high-water at those times, and low-water under the moon: the contrary of what the popular diagrams show. But as these would be correct for an ocean enormously deeper, so are they for Prof. Darwin's "bodily tides." Accordingly the observations of Palmieri, when Vesuvius is most open, find *low-lava* at moonrise and moonset, and *high-lava* following her upper and lower transits. Now when Prof. G. Darwin said, in 1879 ("Phil. Trans.," p. 28), "Unless the viscosity were very much larger than that of pitch, the viscous sphere would comport itself sensibly like a perfect fluid, and the ocean tides would be insignificant," this meant that the form of the sea-surface would not vary. If the bodily tide (which is high under the moon) and the sea tide (which is low under the moon) were *equal*, it is plain that no spot of sea-surface would be a foot nearer the Earth's centre at one hour than at another. But as we neither do nor can measure our high and low waters from the Earth's centre, but only from their own bed, the observable tides would be just the same as if the ground had none; and whether bodily tides be greater or less than the oceanic, and synchronous or not, the latter will appear the same. Yet both Professors repeatedly say (as in "Phil. Trans.," 1879, p. 2), "The only terrestrial evidence of the existence of a bodily tide in the Earth would be that the ocean tides would be less in height than is indicated by theory," and (p. 30), "it is only possible to judge of the amount of bodily tide by the reduction of the ocean tide." I submit that the detection has never been possible this way. The only terrestrial evidence I can see possible is in volcanic observations like those of Palmieri.

But Prof. Darwin, in the only place where he reasons from a measured fact, namely, the unexplained residuum of the Moon's acceleration ("Phil. Trans.," 1880, p. 481), gets an equation (63), of which he says, "there are obviously two solutions; one of which represents that the Earth is very nearly fluid, and the other that it is very nearly rigid. In the first case, that of approximate fluidity, . . . the semi-diurnal tide [bodily] only lags by the small angle 14′. But this is not the solution which is interesting in the case of the Earth, for we know that the Earth does not behave approximately as a fluid body." (!) Exactly like Hampden, the earth-flattener, with anything he considers to have *one* solution on the theory of roundness. This is not the solution for us, says he, for we know the Earth is not round! The remark I should have thought the only natural one would be—This exactly agrees with what is found at Vesuvius, high-lava but a minute after the Moon's transits; and is the *only* solution interesting us, as we know the Earth never has behaved approximately as a rigid body; and see, alike by pendulum experiments, by dislocating dykes, and by the almost weekly local earthquakes,—narrowly local (by all these far more cogently than by any eruptions),—that she behaves in all points as a very nearly perfect fluid, covered with a scum, and this partly with sea.

The term "crust," applied to the small solid portion, is very misleading, and should be scum; a *crust* conveying inevitably the ideas both of *tenacity* and some ability of *dome-like* self-support, which are both practically absent.

IV. THE INFLUENCE OF LIGHT ON THE COLOURATION OF ANIMALS.

MR. LEWIS, in a paper lately read before the Entomological Society, gave the outlines of a provisional theory of the part due to light in the production and distribution of the colours of animals. Some of his ideas, though they cannot be regarded as demonstrated, are of an exceedingly interesting nature, and deserve attention.

It will of course be admitted that Natural Selection, Sexual Selection, and Mimetism,—though they may weed out individuals whose colours are ill adapted for concealment, or are unattractive to their destined mates, and may, on the other hand, give an advantage to such as happen to be more favoured in these respects,—cannot in themselves produce colouring-matters to be modified. This is easily shown by a reference to the colours prevalent in different groups of animals. We see, *e.g.*, mammals—such as the lion and many of the antelopes—assuming the colour of the deserts which they inhabit. But we do not see any mammalian species which haunt luxuriant grass-lands, thickets, &c., approximating to the green colour there prevailing, as do many birds, reptiles, and insects. We therefore judge that the mammalian system, whilst it is able to ring the changes among greys, blacks, browns, drabs, yellows, fawn-colours, &c., is unable to produce greens, however advantageous such a colour might prove.

From the general absence of colour in the interior of animals, or, in other words, its concentration upon their outer surface, Mr. Lewis argues that light must play a considerable part in the production of the pigments or the structural arrangements which gave rise to such colours.* We cannot, however, admit that colours are invariably absent in the inner parts of animals. Familiar instances to the contrary are the cochineal, the lac, and the kermes insects, the colours given out by certain of the Heteroptera when crushed, the coloured secretions of beetles of the genus *Timarcha*, and the yellow and orange matters emitted by most Lepidoptera in emerging from the pupa.

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* We refer here to the peculiar arrangements in, *e.g.*, the plumage of humming birds, which occasion interference colours in the absence of any pigment.

To proceed: Mr. Lewis contends, as we understand him, that the colouration of animals, especially of insects, is due not to physiological processes carried on within the body, but to the mechanical surface action of the light-rays and of the invisible heat-rays. Thus he holds that the most brilliant, and especially the iridescent, colours appear in animals, or in parts of animals, upon which the rays of light fall in constantly varying directions. As an instance he referred to the varied play of colour so often observed on the necks of pigeons, a part which is almost constantly receiving the sun's rays in a varying direction, whether the bird is engaged in its usual circular flights, or walking about, or is even sitting still—the neck being kept almost constantly in motion. Many other instances might here be given which seem to support this notion. Thus the tail and the neck of the peacock undergo a very varied exposure to light. So does the entire plumage of most humming-birds, and the wings of the diurnal Lepidoptera as they flit up and down in their constantly wavering flight. But there are other cases of brilliant colouration in creatures of very sedentary habits. Few groups of birds are more splendidly coloured than the trogons, which sit, dull and sullen, upon boughs in the shady parts of woods. Not a few ground-beetles, which very rarely fly, and which creep mostly on flat surfaces, are also splendidly coloured.

Mr. Lewis further calls attention to the circumstance that insects which creep upon the ground have their underside black or colourless; such as fly, or as creep upon leaves and flowers, are often gaily tinted beneath. As an affirmative instance he mentioned the genus *Calosoma*. *C. sycophanta*, notwithstanding the splendour of its elytra, is black on its underside. But according to Mr. Bates a certain tropical species of *Calosoma*—which Mr. Lewis did not name—passes its life upon trees, and is brilliant upon both sides. Yet there is a British species of the same genus, *C. inquisitor*, which is chiefly found upon oak trees, but is below of as sombre a tint as the terrestrial species.

Mr. Lewis may appeal with confidence to the difference in the colouration of the upper and lower surfaces traceable in two closely allied groups, the Cicindelidæ and the Carabidæ. The former—of which our common tiger-beetle (*C. campestris*), to be seen on any fine day during the spring and early summer at the upper extremity of Epping Forest, is a typical example—are during all the sunny hours of the day in rapid and unceasing motion, taking short flights, alighting for a moment on the heath or the gravel, and then again soaring away like a flash of green light. Now, with very few and doubtful exceptions, the insects of this form are nearly as gaily coloured on the abdominal as on the dorsal surface. In the Carabidæ, and especially in the true Carabs, we notice a complete reversal of these conditions. Many of the species in question are unable to fly. This, indeed, is universal in the case of the great genus *Carabus* proper.* Their movements upon the ground are much less rapid and frequent than those of the tiger-beetles. In accordance with the difference in the locomotive powers and habits of the two groups, we find the Carabs, even when brilliant upon their upper surface, dull and dark-coloured beneath. As common examples of this we may take *Carabus nitens*, *C. auratus* (so common in France), *C. auronitens*, *C. pyrenæus*, &c.

Mr. Lewis may claim another affirmative instance for his law in the Buprestidæ. These rank among the most volatile of all beetles. In cloudy weather they are rarely to be found, and in the sunshine, even in Europe, they spend much time in the air, and take wing at once if approached carelessly. In warm climates they even flit up and down without apparent motive, dancing in the air with almost the ease of gnats. And in accordance with these great powers of flight they are generally admitted to be the most gorgeously coloured animals known. Not only so, but their abdominal surface is often as bright and as iridescent as their elytra, and as the pronotum. There are indeed a few exceptions: *Sternocera chrysidiodes* (Madras) is black underneath ; so also are *Cyria imperialis* (Australia), *Julidomorpha Bakewellii* (Adelaide), *Stigmodera grandis*, *S. macularia*, and *S. semicincta* (New South Wales), as also *S. nasuta* (Victoria). But so few are these exceptions that we feel at liberty to ask whether there may not be in their habits some anomaly which makes them thus deviate from the bulk of their near allies. It must also not be forgotten that some of the Buprestidæ are sombre both above and below, whilst a few are even more brightly coloured below than above.

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* We have never seen a satisfactory suggestion as to the absence or the mere rudimentary condition of the wings in this fine group. In accordance with the doctrine of Natural Selection the wings must have gradually become abortive because found useless, or inconvenient, but as far as the habits of these creatures are known this is hard to understand. Multitudes of them perish at present in floods, whilst if they had wings they might escape the danger. In populous countries great numbers of them are crushed in the early morning by the feet of workmen and others. The possession of wings would enable the insects to avoid this peril. Being also beasts of prey, the power of flight would give them chance of securing booty which must now escape them.

Next, perhaps, in beauty to the Buprestidæ—and if gifted with less command of wing, yet haunting flowers, and thus of necessity much exposed to the sun—come the Cetoniadæ, of which our common rose-beetle (*Cetonia aurata*) serves as a familiar type. Here also there are very numerous instances of a colouration on the lower surface of the insect rivalling or surpassing that of the upper. Among the exceptions rank *Doryscelis calcarata* (Madagascar), where the under surface is black, whilst the elytra and pronotum are bright orange. Upon the whole it may be said that the results of an examination of this family tell in favour of Mr. Lewis, the upper and the lower surfaces being about equal in beauty. We have not, in the necessarily restricted survey we have been able to make, met with any distinct case of a Cetonian displaying iridescent colours above, and being of a black, a deep brown, or grey underneath.

Mr. Lewis does not seem to have mentioned the interesting fact that both among the Buprestidæ and the Cetoniadæ a few species have deep violet, bronze-green, &c., wings, though in the vast majority of beetles these organs are as colourless as those of a house-fly or a wasp. Careful observation of the habits of these species may perhaps throw light on the cause of this anomaly. It will be remembered that in warm climates a great number of the Hymenoptera have beautifully coloured wings.

Mr. Lewis, if we did not mistake him, referred also to the *Phyllophaga*, or, as they might be familiarly called, the cockchafer group, as being instances favourable to his views. This is strictly correct. Many of these insects, which are good flyers, are given to swarming over the tops of the trees and bushes on which they prey. Many of them have not only brilliant colours, but in such forms as *Catalpa*, *Euchlora*, *Macraspis*, &c., the lower surface is often equal, and often even superior to the upper in colouration.

Other groups of the Coleoptera, however, supply much less favourable, or at least less decisive, evidence. If we turn to the common large dung-beetles of Britain, belonging to the genus *Geotrupes*, we find them black above, and richly coloured with violet, blue, deep green, and bronze underneath. But this, according to the principles laid down by Mr. Lewis, is what we could scarcely expect. The insects in question fly little, save in the twilight. Much of their life is spent in underground burrows, or concealed underneath the cakes of dung upon which they feed. Hence there is little opportunity for either of their surfaces to be exposed to the action of the light. As, further, we find them passing their adult existence often very early in the season, the invisible heat-rays can have here but a very doubtful influence. Besides we find kindred forms, of precisely similar habits, such as *Typhœus vulgaris*, black both above and below, without the least tinge of iridescence.

A still more unfavourable case seems to be that of the small Staphylinidæ, very dull and sombre in colour, yet always on the wing about the latter end of summer and the beginning of autumn, and well known in rural districts to the non-entomological public from their unpleasant habit of rushing into the eyes of passers-by, getting entangled under the eye-lids, and occasioning exquisite pain. These creatures encounter the rays of light to as great an extent, and in as many varied directions, as the Buprestidæ, yet there is no generation of gorgeous colours.

In thus criticising Mr. Lewis's views we speak with very considerable reservation, since his memoir had more the character of a preliminary tentative sketch than of a fully elaborated theory. But we must also remember the very serious objections which have been brought forward by Mr. A. R. Wallace, to the supposed influence of light as a main factor in organic colouration.

V. WHAT IS AN ORGANISM?

By R. M. N.

FROM day to day it becomes less easy to recognise and to justify distinctions which to our forefathers seem natural, broad, and striking. They felt no difficulty in drawing a hard and fast boundary between man and beast, between bird and reptile. To them animals and plants were creatures widely distinct, and incapable of being confounded together. But to them the animal was a lion, a horse, a camel, or, in the hardest case, a frog, a bee, or an earthworm, and such beings were not readily mistaken for a palm, an oak, a vine, or a grass-plant. But the more we have in successive ages learnt about animals and plants, little as it is, the more difficult do we find it to mark off one of these great "kingdoms" from the other. Even among scientific specialists, obstinate controversies and much ink-shed may ensue before it is settled to which section some particular being should be referred.

Still more difficult is it to distinguish by any universal characteristics an organism from a portion of inorganic matter. The question is, of course, hardest to deal with when the organism is defunct, and we have before us merely its fossilised remains. It is not by any means decided whether *Eozoon Canadense* is a something which once lived and died, or a mere mineral structure. Sections of meteoric stones revealed what to not a few microscopists seemed organic forms, and many persons jumped at the conclusion that if dead organisms could thus reach our planet through the depths of space, so might the "moss-covered fragment of another world," which is credited with having been, for us, the beginning of life. The tyro in palæontology is often puzzled how to distinguish dendritic deposits of purely inorganic matter from the impressions of fossil ferns which they often closely mimic. The so-called Brownian or pedetic movements of certain powdery matters when thrown upon the surface of water have seemed to not a few persons evidences of life.

Nay, even when recent animals and plants, or the parts of such, are concerned, many well-educated people might be at a loss if asked: "How do you know that this mass of matter here before you is or was a living being and not a mineral product? Though they would perhaps rarely fail to make a correct diagnosis, they would as rarely succeed in rendering a right reason for the opinion they had expressed.

The first attempt at the definition of an organism is due to Aristoteles, and until recently it might be pronounced one of the most satisfactory on record. He discovered that in a plant or an animal, each part had certain duties or functions to perform; that it was, so to speak, a tool, an instrument or appliance (organon) for the totality to which it belongs. Every such totality, therefore, he named an "organism," that is, a combination of tools or implements. It is curious, as a contributor of the "Journal of Science" hints at,* how completely this original meaning of the terms organ, organism, and organic, has been obscured and lost sight of.

But on further research this definition of an organism was found to be at fault. Not to speak of certain parts in the higher animals which have become abortive and fulfil no function, we have become acquainted with certain low forms of animal and vegetable life which are entirely homogeneous in their structure. Such beings would, by the definition of Aristoteles, be excluded from the world of life and classed as inorganic matter. Hence this definition, able and striking as it is, involves not the essence of the organic, but merely a prominent attribute of its higher forms. Dr. Roux also points out that this definition leaves out of account the activating principle, the "*encheiresin naturæ*" which holds this complex of implements together.

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* Journal of Science, 1882, p. 328.

Self-consciousness has been suggested as the common characteristic of the organic world. Here, however, we encounter a twofold difficulty: we recognise self-consciousness in ourselves, and infer its presence by analogy in other animals. But we cannot demonstrate it to the satisfaction of dissidents in the lower animals and in plants. Some investigators even claim it as the exclusive prerogative of man. On the other hand, there are thinkers who maintain that even the inorganic world is not absolutely unconscious. It is easier to reject this supposition than to meet it with a formal disproof. Hence we cannot accept self-consciousness, or, indeed, any psychic function as the characteristic of the organic.

A mathematical distinction in structure has been suggested. It has been said that an organism and its parts are bounded by curved surfaces, whilst inorganic matter, when it becomes individualised, is included within plane surfaces, terminating in right lines, as we see in crystals,—the globular shape which liquids assume when in small portions,—being the "point of indifference" from which crystal and organism branch out in different directions. Here, however, we find in the lower forms of life, deviations which are fatal to the generality of this law. If we look at the magnified figure of the skeleton of *Xiphacantha*, as given by Sir Wyville Thomson, we find a structure presenting the lines and angles of a crystal. Nor do the different laws of symmetry, observed as prevailing respectively in organisms and in crystals, form the basis of a trustworthy definition. Five-sided symmetry is indeed unknown among crystals, but this fact is insufficient. It may further be said that a crystal if broken carefully is resolved into a number of smaller crystals of the same form, or at least into solids of some definite plane figure, whilst an organism if crushed or broken yields mere irregular fragments. Still, we must remember that certain polyps can be multiplied by section, each part becoming a distinct individual. Some authorities have attempted to find a characteristic of organisms in so-called mechanical memory, that is, the permanence for a greater or less time of effects after their cause has ceased. But this is a universal property of matter in accordance with the law of inertia.

Organisms have also been defined as portions of matter individualised so as to be independent. This attribute, however, is common just as much to every process which is severed by its consistence, or by other especial attributes from its surroundings. Strictly speaking, independence exists nowhere.

Neither can we appeal to the transformation of energy, whether alone or in conjunction with the transformation of matter. This combined action is to be seen constantly in the weathering of rocks, and the evaporation of water.

The consistence of organisms is also not characteristic, though in their active portions it varies merely within certain limits, which may be a needful preliminary condition for the origin and maintenance of life. The percentage of water may range from 12 in certain seeds to 99 in some *Medusidæ*. It should here be remembered that we know of no organisms consisting entirely of liquids or gases without the presence of solids.

A certain chemical composition, common, with slight variation to all organisms, is probably an essential feature, but is yet not the essence of organisation itself, since the chemical constitution of animal and of vegetable protoplasm is probably not identical. These features being all set aside as not affording the wished for distinction, we come to some few considerations of another order.

The first really essential characteristic of organic beings is sensibility, which is common to all living beings, if not to all their parts. It may be considered, according to Roux, as the faculty of organic beings when exposed to the action of heat, light, or possibly of other phases of energy, to modify their form in a manner which cannot be regarded as a mere passive transformation, due to the external action, but is possible only by exciting a certain condition consisting in an intensification of cohesion, or in the removal of hindrances to its action.

Dr. Roux, however, very justly observes that we have here merely a special case of the general reactibility of all bodies. Still, although there are inorganic bodies, *e.g.*, mixtures of chlorine and hydrogen, which on exposure to light undergo a chemical change and become more coherent, being condensed so as to occupy less space, yet reflex movement is distinct to such a degree from all inorganic reactions that it may be regarded as a characteristic feature.

Taken by itself, however, it must be pronounced insufficient. If we imagine other well-known properties absent no one would pronounce any substance as organic merely from its being endowed with this attribute. Sensibility must therefore be regarded as a peculiar and very important subsidiary property.

Dr. Roux lays great weight on the relations of the organic processes to space and time. Under the former head is considered the spacial extension of organisms,—in other words, the kindred phenomena of growth and of reproduction. Growth, however, is no independent property, but indicates merely the quantitative relation of another faculty—assimilation—upon which it must be regarded as dependent. Growth, in the sense of mere enlargement, occurs also in the inorganic world. Thus, crystals may grow, and processes at first limited within a small territory may spread over larger region, as we witness in the formation of mists and clouds. The same may be said of propagation, which is merely growth beyond the limits of the individual, and is also dependent upon the faculty of assimilation.

More light is, in Dr. Roux's judgment, thrown upon the question by a consideration of the time relations of organic processes. These have, as far as we can decide, proceeded without interruption since their first origin. True, we find also inorganic processes which since their beginning have been likewise continuous, differing merely in extent and intensity. The rocks never cease from weathering, whilst the denudation of the land and the evaporation of the sea are unending. There is, however, an important distinction: the inorganic processes involving the transformation of matter continue so long as their outward conditions exist. Thus the weathering of a rock will continue for ever, as long as air, carbonic acid, and moisture are supplied. If it is removed from these influences the process of weathering to the best of our knowledge is arrested for ever, but on re-exposure, weathering is again and at once resumed. This is an important distinction between the organic processes and the various operations we see in play in the inorganic world. In the latter, the outward conditions are, as we thus see, all in all, whilst a vital process has in itself an internal cause of permanence to which the outward conditions are merely subsidiary.

A main attribute of every living being is the power of assimilation. The organic process can convert foreign matter into something homogeneous to itself, re-arrange the molecules of the bodies which it incorporates, and create its own requisites from what may be called raw materials. One inorganic process, indeed,—to wit, flame, or rather, combustion—has the power of assimilating foreign matter, and, indeed, makes, in various important points, the nearest approach to the vital process, as we shall shortly see.

The power of assimilation may exist in very varied degrees, and upon them the permanence of such process will greatly depend. A process may assimilate less than it consumes, as in an ill-fed animal. Here the end cannot be far off. Or it may assimilate exactly as much as it consumes, in which case it can never extend, and is always liable to extinction on the least disturbance. Or, lastly, the assimilation may be in excess of all immediate demands. This is and must be the case in every permanent process. Hence, we find that along with assimilation the next universal requirement of organic beings is super-compensation of daily waste.

We find, too, in organisms, the power of self-regulation. The assimilation must depend on the degree of consumption. As the waste of tissue—the transformation of matter—increases, the introduction and assimilation of nutriment, in the widest sense of the word, must increase also. If increased work is not accompanied by increased hunger, or if nutriment is not attainable, or if when procured it cannot be assimilated, we have as the result the cessation of the process, or death.

But another essential point for the permanence of a vital process is the elimination of what has been consumed, *i.e.*, of the waste-products of the process. Were this process of elimination to go on at one uniform rate, then if the consumption were increased, there would be an accumulation of effete matter, which would react destructively upon the process itself.

It is curious to see how both these features of self-regulation are observed in combustion as well as in life. The more briskly the flame burns, *e.g.*, when urged by a current of air, the more abundant must be the supply of fuel, unless the combustion is to come to a speedy end. The more fuel is supplied the more ashes are accumulated, but under favourable circumstances the more readily they are dissipated by the increased currents of air.

Hence we see that when, in the language of poetry, flame has been always taken as a symbol of life; when we hear speak of it as "hungry," "devouring," &c., there is scarcely a departure from literal truth.

There are, however, certain distinctions between life and flame which Dr. Roux has not brought forward. Flame will go on for ever as long as supplied with appropriate nourishment. Not so life, at least in any individual organism. No amount of food will enable any of the higher animals or plants to live on indefinitely.

Organic life is periodic or cyclical,—combustion not so. The organism has a fixed term of existence, and can grow and propagate itself only during certain terms of its existence, after which it dies away. Flame, if fuel is supplied, may not only last for ever, but can grow and propagate (the two processes being here one) during any part of its existence. But there is yet a more important distinction:—Suppose life extirpated on a planet, or on a single continent, all introduction of ova, seeds, germs, whatever being rigorously excluded, none of the forms of energy with which we are acquainted can call organisms, even of the humblest grade, into being. Life can only, within our experience, spring from antecedent life. With flame the case is quite otherwise. It can be kindled without antecedent flame, so long as the necessary materials are not wanting. Mechanical work can generate combustion, as when the savage kindles a fire by rubbing two sticks together. Chemical action can pass into flame, as when greasy cotton-waste sets fire to a work-shop. Electric action by a due arrangement can set fire to any suitable material, though no flame may exist within ten miles of the spot.

The fundamental attributes and the necessary conditions of life are self-regulation and super-compensation of waste. Where we find these, or where we trace arrangements for their production and marks of their presence, we recognise an organism or its remains.

VI. FORCE AND MATTER.

By S. Billing.

IN the correspondence of the "Journal of Science," May, 1881, is a letter signed "A Lucretian." He asks, "Can any of your anti-monistic contributors reply to the following argument of Dr. Büchner's?—"It is evident that a force can only exist in as far as it is active; but a creative force, the first cause of the world, could therefore exist neither before nor after creation, since both before and after this act it would have to be inactive, and inaction is irreconcileable with force." In your June issue H. M. C. remarks on the above, and his remarks I fully endorse. Dr. Büchner says "a force can only exist in so far as it is active:" this is quite right. Newton says of it, "*consistit in actione sola.*" But using force in its correct technical sense, it is clearly wrong to speak of the first cause of the world as a *force.* If we can give it any name derived from dynamics we should call it an *energy.* But an energy does not depend on activity for existence. The very title of Dr. Büchner's well-known book, "Matter and Force," taken in connection with its object, is enough to show he uses force (*Kraft*) in a vague unscientific manner, and that he is open to the complaint made by Clifford against numerous writers on the subject of force (*see* "Nature," June 10, 1880).

Lucretius's letter appearing shortly after my article, "The Formative Power in Nature," in your issue of February, 1881, and whilst an agreeing controversy was in progress between myself and your valuable correspondent, H. B., I could not but conclude that, although couched in general terms, the challenge was to either or both. It appears to me the arguments there used fully rebut Dr. Büchner's *assumptions,* for really they are no more. The Lucretian's query I determined to answer; the difficulty was the book. I supposed it to be published only in German, and therefore to me a sealed book. I kept the subject in mind, and lately found there was an English translation. These remarks I give as an apology for my long silence. The book is obtained and read, and now for my answer to its first chapter, which really contains the gist of the whole book—and a very insufficient book, when the momentous importance of the subject is considered, I deem it—and I can well join in the wonder its author expresses when he found his work was a success.

The edition I procured and from which I quote contains ten prefaces. Their perusal will show that they are not the work of a philosopher, and are wanting in that dignity of which the late Charles Darwin afforded so marked an example when assailed on every side because of his utterances, which really have reformed natural science. Unfortunately to surface, unappreciative, and unscientific men it is supposed to have afforded data to assail those who think that of NECESSITY there must be a God as the ordinator of Nature. The French revolutionists abolished God, but later workers in the same cause felt the *necessity* of a God, and decreed that if there were no God it would be necessary to create one. Your readers are probably familiar with the answer of Napoleon to the *savans* who were with him in Egypt, when pressing on him their materialistic propaganda. He turned on them, pointing to the heavens, its grand galaxies being visible, and is reported to have said, "It is all very well, gentlemen, but who made all this!"

Before proceeding with my discussion a few remarks may be permitted. I am no bigot, and therefore ever willing to accept truth wherever it is to be found. I neither decry nor accept creeds, deeming the basis of one and all the same—*viz.*, the simple idea of an existing God. The only distinction I find in creeds is, that each endeavours to outdo the other in extravagant assumptions, to which and to the scientific ignorance of their propounders must be attributed the mischief so rife in the present day. How beautiful, acceptable, and logical is the simple conception of God as the creator and maintainer of natural phenomena. Had this idea been maintained in its primitive conception and taught in its integrity, how endearing and grand all social ties would have become. The idea of a universal brotherhood would have been realised with God as our Father. Humanity would then have become an intellectual being, but in lieu we have sense predominant with craft and greed as ruling attributes. I have no sympathy with theologies, but I have with the pure principles—which, alas! are merely ideal—they inculcate. I may be asked, What is God? It is sufficient to reply in the language of the Feduci when invoking the spirit: "I know not where Thou art, or what Thou art, but only that Thou art." It is impossible for man to define what is God: all that can be said is, that in phenomena we witness His manifestation, for therein we see intelligence embodied. If Professor Max Müller and those who worked in the same field have rightly construed their theories, if the cuneifom inscriptions and Egyptian hieroglyphics stand for anything, we must conceive man had a conception of spiritual things and a belief in an immortal principle or soul: the fact is intruded in the earliest historical records. Palæontology also brings its evidences. The Cro-magnon race contemporary with the great mammals had a belief in another life, M. Quatrefages (" Human Species, p. 328) says:—" The care bestowed upon burial places shows that the hunters of Mentone, as also those of Salutré and Cro-magnon, believed in the wants of their dead beyond the tomb. Our acquaintance with the customs of so many savage nations of the present epoch forbids any other interpretation of the interment of food, arms, and ornaments with the body." It is a fair presumption that when man emerged from the animal *Homo sapiens* there was ingrafted in his intelligence (whatever its character) the religious sentiment. However crude it may have been, it is the power which has transformed our race and made it something more than animal. Speaking of Atheism, M. Quatrefages says:—"Obliged in my course of instruction to review all human races, I have sought Atheism in the lowest as well as in the highest, I have nowhere met with it except in individuals, or in more or less limited schools, such as those which existed in Europe during the last century, or which may still be seen at the present day" (*Ibid.*, p. 482). He further says:—"In these researches I have proceeded and formed my conclusions, not as a thinker, a believer, or as a philosopher, who are all more or less under the influence of an ideal which they accept or oppose, but exclusively *as a Naturalist*, whose chief aim is to seek for and state *facts*" (p. 483).

"Force and Matter" is the title of Dr. Büchner's work; had its title been Matter and Energy it would have been more in consonance with scientific ideas. Had the argument been conducted in a spirit of inquiry as to the existence of a formative power in nature and the confutation of a received idea, *i.e.*, the creation of the Universe by God, no one could have objected, for then the author would have stated his problem and enforced it with such scientific acumen, philosophical reasonings, and common-sense illustrations as he might be acquainted with. When he begins by saying, without adducing any arguments in support of his theorem, that those who talk of a "creative power" "are ignorant of the first and most simple principle found by experience and the contemplation of nature;" and in the same page (p. 80) he also says, "So the absurdities attending a belief in an individual creative power, &c." To quote the whole of such expletives scattered throughout the work would fill too large a space; those adduced must suffice for examples. They who are curious in such matters can consult the work, and I venture to say will be satisfied *ad nauseam*. Any person who really consulted the work with the desire to profit by the argument would by their continual occurrence not only be filled with disgust, the idea would also be present that the author, being wanting in reasoning power, endeavours to make up his deficiencies by invective and dogmatic assumptions. Even when passages of any force occur they are marred by the same fault. By the course he has pursued, Dr. Büchner must think that his assertions and assumptions are superior to all scientific, philosophical, and commonplace reasonings that can be adduced in contradiction. If he be convinced of his premises, it is quite allowable that he should endeavour to convert others to his views. An orderly presentment of his argument might attain such object, but the course he has pursued never yet convinced any one who really has the power of collating, weighing, and considering the arguments adduced. Doubtless, the course pursued may have had weight with incapable and semi-scientific persons, and also with those already possessed by Dr. Büchner's peculiar ideas; but with those who are conversant with the propositions and reasonings to be adduced on such subjects, the treatise would be in effect powerless.

The first chapter, "Force and Matter," in which the potency of force and matter in creation is asserted and the impossibility of there being a creative power, contains the pith of the whole work. But it is well to bear in mind the teachings of Professor Huxley in his lecture "On Descartes's Discourse on Method." He says: "I am prepared to go with the Materialist wherever the true path of Descartes may lead. . . . But when Materialists stray beyond the borders of their path and begin to talk of there being nothing else in the universe but matter and force and necessary laws, I decline to follow them. . . . Matter and force, so far as we know, are mere names for certain forms of consciousness."

"No force without matter—no matter without force, neither can be thought of *per se*. Separated they become empty abstractions" (p. 78). In other words, force and matter are so intimately entwined that without the one the other could not be. The author adopts Mulder's observation, "that forces cannot be communicated but merely called into action." From this it would seem to follow that the forces are inherent in mattter, and it would then seem that force and matter are synonymous terms. It is possible that in the origin, so far as matter is concerned, there was but one condition, matter or fluid, and that out of it all phenomenal combinations have resulted. The conclusion that Dr. Büchner appears to draw is, that the correlate forces "are but changes in the aggregate state of matter." "Light and heat are vibrating, undulating bodies." "Electric and magnetic phenomena (Czolbe) arise . . . like light and heat from the reciprocal relations of molecules and atoms." Molecules and atoms, Professor Huxley has said, are but imaginative symbols, and that he who mistook them for real quantities would err equally with the mathematician who should so mistake his *x*'s and *y*'s. At all events, no one has ever seen the one or the other. In a work so exacting as that in question no words should be used expressing forces or substances that are not the tangible or visible results of observation and experiment. We know that matter is divisible into the minutest particles, but of these particles there is no proof that they are either atoms or molecules. A substance is pounded into the merest dust, and can be further disintegrated so as to become undiscernible by the minutest microscopical tests. Professor Crookes has shown that matter can be resolved into a fourth state and a beyond—darkness. Professor Tyndall has shown that there is light only when there is a substance to reflect it. Here there appears to be neither substance nor force; what then becomes of this indestructible matter, on which our author so pertinaciously relies? "Nothing but the changes we *perceive* in matter could ever give us any notion as to the existence of a power which we qualify by the name of force" (p. 79). By Mr. Crookes's experiment matter has been pursued into an ultimate range wherein neither matter nor force could be perceived. And further we must remember that, however identical matter and force appear to be, the static state never becomes the dynamic without an impulse; the impulse is foreign to or outside that in which the action occurs. Surely there must be a something (whatever that something be) besides force and matter. It follows, as a necessary consequence, that were there no external impulse, force and matter would have for ever remained enwrapped in the embrace of the one and the other, and this glorious world, which we know as a world of action, would have been an utter void phenomenon, and its realities would never have been.

Truly we are cognisant of the action of force only by means of the senses; but when the question is of power, we have quite another subject to consider. There are mental powers which act from within and create, *e.g.*, pleasures and delights, distress and miseries. These powers are wholly without the scope of the senses, however they may react on them.

Because we know the action of force by means of the senses the author jumps at the conclusion that the world cannot have been created. He continues, assuming a creative power, soul, &c.:—"Time could not have existed before or after creation; it could not have existed before because the notion of power is not reconcileable with the idea of nothing or inactivity." "It could not have existed after the creation, as rest and inactivity are again incompatible with the notion of force." A steam-engine has always its force, although not always manifested. So a man may be intensely intelligent, yet not always exerting his powers. Watt employed the reflection of years before he presented his thought to the world enbodied as a steam-engine; but by the act his intellect was not impaired. Time, as we understand it, is an invention of man to suit the circumstances under which he exists, and is really but the way mark for a succession of events. "A force which is not manifested does not exist." Does the author understand the meaning of the static and dynamic states of force? One would think not, because he says that a force not manifested "cannot be taken into account in our reasoning." He then says, "there remains but a third possibility . . . that creative power has suddenly and without any occasion arisen out of nothing—had created the world (out of what?), and had again in the moment of completion collapsed within itself, and, so to say, dissolved itself into the universe." Intelligence may be used and by use become more powerful; repose, to awake again in its pristine power; and so it may be that when the creative power embodied its intelligence and presented a world with all its necessary energies, the intelligence relapsed within itself, again to be used, and so on to all eternity, but never spent by action.

Helmholtz says that "there is no mechanism but that which is the result of intelligence," and if we go to our world life, we find no invention that is not an embodied thought. We see the machine, we also see in it the embodiment of the intelligence of its inventor. We look on a grand picture. What do we admire, the paints or their arrangement? In their disposition do we not see the mind and skill of the painter staring at us from his canvas? We do not suppose the glorious conception thereon embodied was the accidental arrangement of the pigments. The painter's mind is interfused into his work. He embodied the ideal his mind presented, and it is that mind which excites its sympathetic action in the mind of the beholder.

This argument being extended makes it possible (assuming that there is a creative power notwithstanding Dr. Büchner's assertion that there is not) that the creative power having completed the nucleus, out of which the glorious panoply we term nature arose, by an interfusion within this nucleus of the intellect and energy which conceived it, and then became sufficient for its own development and maintenance; hence this energy, which is the inherent power of phenomena, is always active. This is a simple conception of creative power

—of God if you will—but in it there can be no idea of His "reposing after creation," but yet as an individual capable of again suspending his own laws."

The idea of a god, other than those of the vulgar, was entertained by Plato, Socrates, Epicurus, Aristotle, and others of the Greek philosophers. The abundance of the myths of ancient Greece shows the religious reverence the people had for their gods. Their superstitions being excited, the gods were personified and pictured as caretakers, and were supposed to be present in the minutest relations. They were, in fact, the presiding providence of the people (*vide* "Grote's Greece," vols. i. and ii.) If Dr. Büchner had not been engrossed by preconceived views, his comments would have been directed to that conception of God which engrosses the minds of philosophers rather than to those phases of His being delineated by ecclesiastics. Mr. Herbert Spencer ("First Principles," p. 37) says:—"We cannot think at all about the impressions which the external world produces upon us without thinking of them as caused, and we cannot carry out an inquiry concerning their causation without inevitably committing ourselves to the hypothesis of a first cause." And when Dr. Büchner says the unknown is to be interpreted by the known, the question at issue appears to be decided. Chemistry and mechanics, as we know them, are all developed by the intelligence of man; and so, by a parity of reasoning, it is a fair conclusion that the chemistry and mechanics of nature were the result of intelligent direction. It appears idle to imagine that the framework of the universe, or even the mechanism of an animal, could have arisen from casual adaptations. There is a grand series of formations extending from the protoamœba up to man. How could their orderly arrangement have arisen excepting by an internal energy engrafted by an intellectual power into the germ, endowing it with the capability, by slow gradations, by differentiation, adaptation, and development to attain that perfect fitness which is found in all organisms. We have something more here than force and matter and necessity. All forms of life are a pushing from a vital centre. Aristotle held that the universe originated from one unmoving centre.

From all we glean from nature, we are bound to conclude that the purpose and plan of objective phenomena was conceived once for all, and that there were no tentative efforts and corrections. The mystery is not so much the differentiation we everywhere observe as the principle or power by which they are produced. The conception of the plan of the evolution of forms—the homogeneity everywhere observable shows its factor was an intelligence, or we should not have gradations of development, as proved by the successive phases of embryonic changes, for it would have been as easy to have presented the perfected forms.

What then is the architect of nature, God or accident? The former alternative has been considered. Accident, not one but an interminable succession, and so opportunely occurring that when the necessity arises an accident is ready to meet it, and these successions are so endless and of so precise a character that they create uniformity and order, adapt parts to parts, and each to the whole, not one whole but many millions of wholes for each organic form, whether animate or inanimate, due to a fortuitous concurrence of chances. If Dr. Büchner would apply his mathematics, for that is the scientific test now-a-days, and lived a life as long as the world has had being and had space for his numerals, he possibly might find the sum of the chances by which all these accidents would coalesce and produce unity. Such assumptions—they are not reasoned hypotheses—have no basis for argument. All will agree with Liebig "that no force can originate from nothing," and with Czolbe, "an absolute nothing is not cogitable." What, then, is the *something* which sets matter in motion? Dr. Büchner does not tell us whence, where, and what was the originating impulse. Were the universe alone possessed by matter and force, we should have but inertia, no grind of worlds, no animate forms, a universe of nothingness. Day by day we see the human intellect creating, yet intelligence is not matter, although it uses matter in its embodiment when it becomes phenomenal. What, then, is this something but intellectual energy which disintegrated the chaos (the voluntary motion of Lucretius?), assorted its elements, and which condensed and gave to them orderly assimilations. The true and common-sense solution of all cosmic problems is, the originating cause, be it what it may, produced an effect, and this effect produced another effect, and so became the cause of the latter; so every effect becomes the cause of the succeeding effect, and so on to the end of the chapter. Thus we have a continuing beginning—an increasing energy instituting an untiring action—all due to the originating impulse, which of *necessity* is independent of the force and matter on which it acts.

If we could adopt necessity (*causæ efficientes*) as the acting impulse we still have a something alien to the thing acted on, and we should also remember that with our ideas as to natural results there are many things in nature which we deem unnecessary, *e.g.*, diseases, parasites, &c. Necessity would cease when the needed forms were produced, inorganic and organic, and such phenomena as are necessary for their support and maintenance. No creature would require more than an instinctive power for generation, preservation, and adaptation to climatic changes. If, then, all that is animate is to become inanimate, there would be but a succession of changes; and man, what place could he have in this scheme of necessity?

Can we conceive that the purpose of creation is accomplished by man being born but to die? We can conceive that the wondrous development of organised forms was instituted that man might be; but if there be after this life no beyond for intellectual man, he exists but as a thought, and expires in its utterance; and all we know of that immensity, the universe, is as of an ingenious and wasted mechanism springing from nothing and ending in nothing. Intellect in such a corollary would be no necessity, but whence this necessity? Did it create itself and its own impulses? If so, we do not seem far short of an intelligent creator; but then this necessity is governed by law—whence came these laws? Accidental recurrences! Law implies not only a law given but a law maintainer; hence intelligence direction. If this be the outset of *causæ efficientes*, do we appear to be very distant from the *causæ finales?* Experience shows there is no finality in the finite. Each man in the impressiveness of his own consciousness must judge in his own conceptions—by faith or by facts, a God and intelligence, no God but matter, a creator or a chance. God the universe and man as a collective fact (whatever be the postulates of Faith) is an open secret only to be resolved in the Unknown.

POSTSCRIPT.—Dr. Büchner's work, "Force and Matter," was read by me with the intention of comment and answer; but I find the intended task was completed even before I had heard of Dr. Büchner (if I except an isolated observation occurring in Dr. Elam's "Winds of Doctrine"). My observations are mostly confined to the first chapter of the work—viz., Force and Matter, with its incidents, necessity and the no God hypothesis. If Lucretius is unsatisfied and requires further answer, I refer him to my work, "Scientific Materialism," where he will find all the hypotheses of Dr. Büchner anticipated, argued, and, as I conceive, refuted.

VII. HARVEST SAVING: THE READING COMPETITION.

IT might reasonably be expected that the Royal Agricultural Society of Great Britain would be the very foremost body in the kingdom to promote means for arresting the severe loss which we seem destined to undergo from bad weather at harvest time,—a loss estimated at the average figure of six millions sterling yearly. But what must we think when we find this powerful and influential organisation, not merely looking on in apparent apathy, raising no finger to put an end to this national calamity, but as far as in it lies seeking to discredit the efforts of private individuals?

The results of the Reading trial are, we must say, exciting both surprise and indignation, and many persons are beginning to ask what is the *raison d'être* of an Agricultural Society which can thus mistake its duties? The facts are simply as follows:—Mr. Sutton, the eminent seedsman, of Reading, doing what the Society has strangely omitted to do, offered a prize for the best mode of drying hay artificially, and the Society then appointed three judges to decide. Mr. Gibbs, whose drying machine we have noticed on two former occasions, rightly considering that its efficiency had been already proved in practical working beyond all reasonable question, declined to compete. A gentleman, however, who had bought one of these machines and used it with complete success on his own farm, sent it in for trial. Only one other apparatus on a quite different principle appeared on the field. The material to be dried consisted of coarse marsh-grass, which had been shaken out by hay-tedders whilst the rain was falling, exposed on the ground to five day's rain, so as to get as wet and dirty as it could. As a morning paper aptly says: "It was trampled and kicked about by enraged visitors, and rolled in by nearly all the dirty little boys and girls of Reading." Being in this condition, the Gibbs machine dried it in six hours, so as to be fit for stacking. It has since been sold by public auction at the rate of £3 6s. per acre. The grass dried by the other process, after being under treatment for a much longer time, only fetched one guinea per acre.

Of course all right-thinking persons will conclude that upon the facts before them the judges could have no other option but to award the prize to the Gibbs machine. But no: a man "convinced against his will" can generally find some loop-hope for escape. The judges therefore refused to award the prize at all on the singular ground that this system did not make such good hay as could be produced by field-work! Were this assertion as true as it is inaccurate it would still be no justifiable plea for withholding the prize. The farmers' difficulty comes from the fact that in many seasons field-work is useless. There are persons who question, not only the fairness and the logic, but even the legality of the decision. Suppose a prize offered for the best make of artificial teeth: could the judges refuse an award on the ground (true or false, as the case might be) that the best were, after all, inferior to natural teeth?

We could with very little trouble put our finger upon a man, who, at this same Reading trial, overheard a gentleman connected with the Royal Agricultural Society exclaim: "Oh, this is the scheme I threw cold water on at Manchester, twelve years ago!" We hope this gentleman feels that he has not lived in vain. He has done what in him lies to prevent a useful invention from being adopted, and to perpetuate a heavy national loss. It is true the agricultural papers with one accord admit the value of the Gibbs machine; it is true that the testimony of such gentlemen as Mr. G. P. Fuller, of Neston Park, Corsham; of Dr. Tristram, Q.C.; of Mr. Botting, manager of the Duke of Northumberland's home farm; of Mr. C. J. Morris, J.P., of Wood Eaton Manor, Stafford, &c., ought to outweigh the results of this unfair award at Reading. But, unfortunately, very little is needed to encourage the British farmer in his almost fatalistic apathy under removable evils, and his reluctance to accept the means of safety when offered. How we, with our method of treating inventors, ever became a great industrial nation is a miracle.

VIII. SAFETY CHEQUES.

IT not unfrequently happens that when an inventor has devoted years to perfecting some idea and bringing it into a practical, business-like shape, and finally secures his results by means of letters patent, others appear upon the scene and offer us something aiming at the same object.

Thus, once upon a time, all the world was inventing new methods of obtaining red colouring-matters from aniline oil. Another time all the world was no less busy devising new forms of roller skates. More recently all the world is up to its dazzled eyes in electric appliances, seeking to produce lights, whether "incandescent" or "arc," cheaper and more manageable than anything which has gone before. Hence, it appears that there is a class of inventors who seem always ready to turn their minds to any subject which attracts public attention. Among such less sensational, but still very important, subjects, we may mention methods of preventing a very dangerous fraud of the day,—the alteration of cheques after they have been filled in and signed by the drawer.

This problem appears to have been solved in the most satisfactory manner ("Journal of Science," 1881, p. 104) by Mr. A. Anthony Nesbit, F.C.S. His cheques have been pronounced by chemists profoundly versed in the properties of colouring-matters to be absolutely incapable of fraudulent alteration. So that on this score no improvement is needed or is even possible. But, of course, if any future inventor can give us *equal* security at a *less* cost for materials and labour, and with *less* trouble, he may claim the superiority. Has this been done, or is it likely to be done? The Nesbit process requires no specially prepared paper; any ordinary quality used for cheques will suffice. No complicated engraving is needed: the cheque is merely tinted with one of the colours, which are changed in different ways respectively by acids and by alkalies, and is then printed, a part of the design with an acid and another part with an alkaline ink. Simplicity, despatch, and economy in materials and labour can scarcely be carried further.

One of the two attempts which have since been made to supersede the Nesbit cheque is not proof against alteration, as we have seen experimentally proved. A third process has been devised and patented by Mr. Nowlan, and is chiefly remarkable for its great complexity. As far as we understand the specification and claim—the latter not remarkable for clearness—Mr. Nowlan's cheque is to consist of two or more layers of paper, as thin and transparent as possible. These leaves are printed with certain colouring-matters, some of them alterable and others permanent, and are then cemented together with their printed sides innermost. The designs, lines, letters, &c., will then have to be read *through* the uppermost paper, upon which, of course, the drawer's signature and the sum will be written.

We have never seen any experiments performed upon a cheque of this kind, and have therefore no right to say that it admits of being tampered with. But, supposing that, like Mr. Nesbit's, it is absolutely secure—and it cannot be more so—how do the two compare for convenience and simplicity? It is obvious that each layer of Nowlan's cheque will require at least as much time, trouble, and expense in printing as an entire cheque on the Nesbit system, and after all comes the cementing together! A word as to this same cementing process: We find Mr. Nowlan saying that the cement used must, on the application of moisture (*i.e.*, for the attempted separation of the two sheets), induce spreading or blurring of the pigments, &c., and thus spoil the cheque. But if this is the case, what will happen when the wet cement is first applied to the sheets in order to fix them together? Will not blurring or spreading at once take place?

Reserving, however, all questions of this kind, we contend that any man capable of understanding the facts of the case will at once assign the palm of merit to Mr. Nesbit's process as compared with any other as yet known.

ANALYSES OF BOOKS.

Proceedings of the Society for Psychical Research. Vol. I., Part 1. London: Trübner and Co.

The "Society for Psychical Research" organised at the beginning of the present year is no mere demonstration. To work it has gone with a good will, and in the pamphlet before us it gives the first-fruits of its activity on a much-contested subject. "Thought-reading" has, thanks to the public exhibitions of Mr. Bishop and Mr. "Stuart Cumberland," attracted no small portion of attention. Journalists—scientific, unscientific, and even anti-scientific—have opened their columns to records of incidents which forty years ago would have been curtly rejected. Without an unpardonable digression we may here remark that there is at the present day a decidedly increasing relish for the so-called supernatural. What this change in the public taste signifies it would be rash to predict. A sceptic has, indeed, ventured the very just remark that all our social intercourse is based upon the assumed impossibility of our thoughts being read otherwise than through language, signs, gestures, changes of countenance, and the like. Yet at the same time certain of the experiments performed, if correctly reported, seem to indicate that the thoughts of any person may, under certain circumstances, become known to others without any of the usual means of communication. It is natural and right that all such experiments should be scrutinised with jealous care, and that every opening for fraud, collusion, and self-deceit should be eliminated. To do this has been the especial task of the Special Committee on Thought-reading.

This Committee, in a Report given in to the Society July 17th of the present year, states that "The present state of scientific opinion throughout the world is not only hostile to any belief in the possibility of transmitting a single mental concept except through the ordinary channels of sensation, but generally speaking it is hostile to any inquiry upon the matter." We cannot venture to impugn this assertion, but we must regret that the latter clause should be true. Science, we think, should not refuse inquiry except in cases where there is a *prima facie* absurdity in the way. We may perhaps here usefully attempt to settle when an inquiry may be safely and justly refused as waste of time, and when it should be undertaken. Suppose a man who has scarcely mastered the elements of arithmetic, and who is totally ignorant of the higher mathematics, comes forward to point out errors in the astronomical calculations of Leverrier; suppose another, in the teeth of a vast and ever-increasing mass of evidence, tells us that the earth is flat, and that phosphorus is soluble in water as such ; suppose that a third, without any systematic knowledge of biology, without any original observations or experiments, undertakes to overturn what is commonly called "Darwinism," we are not bound to undertake any formal refutation of their errors. Before they could understand our arguments they would be compelled to acquire knowledge which they at present do not possess. But, on the other hand, if a man habitually truthful, sober-minded, and having no personal interest in the matter, lays before us some novel fact which he has observed, we have no right to refuse him a hearing because no such facts have been registered before. To take a very simple instance: it has been held, on the foundation of general experience, that none of the many species of lizards known to Science were capable of inflicting a venomous bite. Latterly, however, a species of lizard has been discovered in Mexico which possesses true grooved teeth and poison-glands, and whose bite proves deadly to small animals within a few minutes. Hence the inductive conclusion that "no animal having legs can instil poison by biting" has been set aside as founded on too narrow a basis. In like manner a wider experience may compel us to reconsider other inductions, and hence we should never dismiss the records of facts on the mere ground of their unexpected nature.

In the Report before us an abstract is given of Dr. Beard's summary of the sources of error in experimenting upon living human subjects.* But the writers think that he has omitted one source of error more fatal than any other to a right interpretation of the facts, namely, a strong prejudice against the possibility of the phenomena in question. They admit, however, that before a promiscuous company experiments of this kind are nearly sure to be vitiated by some of the sources of error which Dr. Beard has pointed out. These objections scarcely apply to the observations made by Prof. Barrett upon the Creery family. There was on these occasions often no person present who could, even if so disposed, have given any hint or indication as to the word or object thought of. Often, too, no one save the experimentalist knew the name, the word, or the object which he was thinking of, and which one of the daughters of the Rev. Mr. Creery, or his maid-servant, succeeded in guessing—if the word may be used. The failures, we think, will prove quite as instructive as the successes. Prof. Barrett writes that the first test was to name the hiding-place of some small object chosen by himself. The children succeded in only one case out of four. The next demand was to give the name of some familiar object agreed on in the child's absence. Here there were six successes out of fourteen cases. Perhaps the hardest trial was to think of imaginary names, which the children were to guess; they succeeded in five cases out of ten. Three cases were complete failures; but in the two remaining the names given had a resemblance to those which had been fixed on. "Jacob Williams" was given as "Jacob Wild," and "Emily Walker" as "'Enry Walker," the guesser in the latter case being the maid-servant.

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* *See* Journal of Science for July, 1881.

In the second set of experiments, performed with the same children, by Messrs. Myers and Gurney and two ladies who were entire strangers to the family, we remark that of three fictitious names to be guessed all were failures, but that in two of these cases the names guessed were somewhat similar to those which had been selected by the experimentalists. For "Martha Billings" they guessed "Martha Biggis," and for "Catherine Smith" "Catherine Shaw." In guessing a card selected at random out of a pack they were successful in nine cases out of fourteen. On two other occasions there were eight consecutive successes, once with cards and once with names. These results practically exclude coincidence, since in the former case "the adverse odds were over 142 millions to 1, and in the latter incalculably greater."

In other cases "Chester" was guessed for Leicester, "Freemore" for Frogmore, "Singrore" and "Grover" for Snelgrove. It is conceivable that by collating those cases where the word guessed approximates to that selected some light may be thrown on the method in which thought is communicated from one brain to another. We hope that the Committee will therefore continue their interesting observations, though we scarcely see that the evidence thus obtained can be decisive as against the materialistic philosophy.

The Victorian Review, August 1st, 1882. Melbourne: The Victorian Review Publishing Company, Limited.

This number may be noticed as containing one of the most able and thoughtful of the many articles which have been called forth by the death of Charles Darwin.

The author, T. Jeffrey Parker, fully appreciates the man whose eulogium he delivers at the Antipodes. He declares that "in an age of eminent naturalists it occurs to very few to question the right of Darwin to a position above them all as the father of modern biology." He then, as a key to the position, gives a brief sketch of the history of philosophical biology as distinguished from the mere collection of desultory facts. He notices the labours of Wolff, Linnæus, the elder Darwin, and Buffon. He considers that the last of these worthies "would in all probability have given the world a far more consistent theory of Evolution than that we now find scattered up and down the numerous volumes of his 'Histoire Naturelle,' had it not been for the blighting influence of the Sorbonne." He adds in a note that on first reading Mr. Butler's "Evolution Old and New" he was "greatly taken with the theory that the passages in the earlier volumes of the 'Histoire Naturelle' which avow a belief in immortality are ironical. But on reading Buffon himself I find the theory rather more difficult of acceptance."

Among the naturalists of the beginning of the present century Mr. Parker notices Goethe, Treviranus, and Saint-Hilaire, merely in a footnote, and overlooks Oken altogether. Of Cuvier he takes, in our opinion, a too favourable view. He describes that great type of the official bureaucratic *savant* as "devoting himself to facts." True, always provided that such facts did not militate against his preconceived theories, such as the immutability of species, the recent origin of man, the series of geological catastrophes, and the like. But we have heard of certain fossil human remains which he declined to examine, and which were ultimately mislaid. Preserve us from such devotion to facts!

The author, however, in maintaining that, from the disappearance of Lamarck to the publication of the "Origin of Species," philosophical biology was completely in abeyance, overlooks the so-called "Representative System" of Macleay, Swainson, Vigors, and their adherents. This system, sometimes known as Quinarianism, collapsed not on contact with Evolutionism, but by its own internal feebleness. Yet at one time it completely dominated British natural history. It tinctured the writings of Kirby and Spence, of Edward Newman, Stephens, of Professor Westwood, as well as the biological portions of "Lardner's Cabinet Cyclopædia," of "Knight's Penny Cyclopædia," and of other standard works. Nor without at all overlooking its many extravagances can we say that it does not contain the germs of certain truths which it might not be labour lost to extract and to purify.

To return: full justice is done by Mr. Parker to the singular philosophic caution of Darwin in refraining from publishing his views until he had fully weighed the evidence upon which they rest. This point has a further bearing. Our great leader has been accused of a reticence bordering upon dishonesty for not at once extending his theory to include the human race. But the man who after five years' work merely allowed himself to speculate, and who, not until the end of two more, merely drew up some short notes, not yet for publication, but merely for the criticism of one or two friends, was simply true to Science and to himself in allowing twelve years to intervene between the appearance of the "Origin of Species" and that of the "Descent of Man."

Mr. Parker gives a somewhat humorous sketch of the great

Darwinian controversy which, he considers, is approaching its final stage:—"The opinion has already been advanced that St. Augustin, St. Thomas Aquinas, and Father Suarez were Evolutionists, and I should not be in the least surprised if before long the same discovery were made with regard to Knox, Calvin, and Wesley. Certainly a very good case could be made out for Dr. Watts; a line in one of his hymns—'From change to change the creatures run'—is simply Evolution in a nutshell."

But let us not exult prematurely. Ignorance has learnt the art of organisation, and evil days may yet be in store not for Evolutionism alone, but for Biology in general, and for Science altogether.

The Solution of the Pyramid Problem, or Pyramid Discoveries, with a New Theory as to their Ancient Use. By ROBERT BALLARD, M.I.C.E. New York: Wiley and Sons.

INDEPENDENTLY of the recent Egyptian troubles, the pyramids have of late years attracted a great and increasing amount of attention. Most of our readers will be more or less acquainted with the views of Mr. Piazzi Smyth, the Abbé Moigno, and others, who look upon the Great Pyramid as a divinely inspired record, embodying profound astronomical, mathematical, and meteorological truths.

Mr. Ballard considers that the builders of the pyramids were by no means devoid of mathematical knowledge. These structures he considers were not erected aimlessly, but to serve a very important practical purpose. In Egypt the annual overflow of the Nile is apt to render the boundaries of lands doubtful: hence rapid and efficient means of surveying were needed. These means were furnished by the pyramids, the respective positions of which are important. The Cheops stands at the acute angle of a right-angled triangle, of which base, perpendicular, and hypotenuse are to each other as 3, 4, and 5. Mycerinus is at the greater angle of this triangle. Cheops is situate at the acute angle of a right-angled triangle, of which base, perpendicular, and hypotenuse are to each other as 20, 21, and 29. He considers the Royal Babylonian cubit (= 1·685 British feet), which seems to have been used by the builders of the Pyramids, as the most perfect ancient measure yet discovered: 77,760,000 of these cubits are equal to the polar circumference of the earth.

Our author does not, like Mr. Piazzi Smyth, find any striking difference between the pyramid of Cheops and the rest. "That one particular pyramid should have anything to do with the past or the future of the lost ten tribes of Israel" seems to him "the wildest conclusion of all, except perhaps the theory that this one pyramid points to the future of the British race." He recommends that the pyramids should be re-cased, when their value for surveying will at once appear. At the same time he admits that they may have had subsidiary uses, and recommends borings near and within them for the purpose of detecting subterranean vaults.

The author of this interesting work may be communicated with at Malvern.

The Field Naturalist and Scientific Student. October, 1882.

In this issue we find some very interesting matter. Dr. R. Angus Smith, who rarely touches upon any subject without saying something worthy of note, gives a paper on National Voices. The peculiarity of the Scottish voice has, it appears, previously been remarked. Now Dr. R. A. Smith, when in Germany, heard an engineer explaining an apparatus for cutting and preparing peat, and was struck with his voice, which had a distinctly Scottish character. The speaker was, it appeared, not a true German, but a native of Slesvic, from which region many of the so-called Saxon immigrants to Britain must have come. In spite of the lapse of time and of many changes the vocal character has thus clung to the race on both sides the sea. Such similarities, Dr. R. A. Smith suggests, may be useful in tracing out the affinities and the wanderings of nations.

A note by Mr. H. Kerr raises the question as to the introduction of the wild cherry into England and Scotland. It may be remarked that in some parts of the North of England this species is known as the " merrie " tree,—a synonym pointing to its French name *mérise*, and perhaps an additional piece of evidence in favour of its having been introduced into Britain by way of France.

A lady who uses the signature Rosa pleads for the " popular names of birds and plants as each contributing a little information." But what if the information thus contributed is incorrect ? Dr. R. A. Prior communicates a paper on " Errors in the Popular Names of Plants." Here he informs us that for more than 300 years the name " Forget-me-not " was given to *Ajuga Chamæpitys*, whilst our Forget-me-not then went by the clumsy name of " Mouse-ear Scorpion-grass." The change of name is said to have taken place as recently as 1821. We must, however, remark that the new nomenclature with the legend of the drowning lover took root very rapidly. In 1835 we were shown the precise spot in the Rhine where the gallant knight had perished in the treacherous embrace of the water-weeds, and the story was represented to us not as a modern invention, but as a veritable old Volksmärchen.

The question "Do fishes feel pain?" is answered in the affirmative by W. J. V. Vandenbergh. Mr. Cuthbert Oxendale gives an instance of a cat hooking fishes out of a mill-lodge with her claws, and is of opinion that if the taste for fish had been old in cats they would ere this have taken to swimming.

Mr. Leo H. Grindon, in an article on "Poisonous Plants and Harmless Ones," ventures on the bold statement that "we may be sure that nothing in Nature has been created without a purpose benevolent in the end."

Our Medicine Men: A Few Hints. By H. STRICKLAND CONSTABLE. Kingston-upon-Hull: Leng and Co.

Fashions of the Day in Medicine and Science: A Few more Hints. By H. STRICKLAND CONSTABLE. Kingston-upon-Hull: Leng and Co.

WE have in these two volumes a mixture of matter, wise and absurd, original and thread-bare, grave and gay, to the point and very much beside it, of anecdotes and quotations, all embedded in a gangue of anti-vaccinationism. Some years ago, we are told, a child of the author's nearly died from vaccination. "Hence this book."

To find a man who could either approve or disapprove of all that is here written would be impossible, and to expound and discuss all the various views here brought forward would occupy at least a yearly volume of the "Journal of Science." Therefore, after pointing out that, according to the Introduction, by "Our Medicine Men" the author means "our professors of the art of healing, our professors of physical science, and our professors of religion," we will proceed to lay before our readers a fair selection of the views here set forth.

In Appendix A, as well as in a number of scattered passages, we find A. Comte dealt with in a well-deserved and therefore not laudatory manner. He rightly reminds us that, according to the best authorities in every department, Comte was, scientifically considered, simply nothing. He conducted no researches; he made no discoveries, and was even not well versed in what had been done by others. He had some appearance of being a mathematician, but Arago tells us that even in that discipline he is not worth notice. And if we test his merits in other directions we find him upholding the dualistic chemistry of Lavoisier when already tottering to its fall, and closing his eyes in biology to the dawn of Evolutionism. We may well ask, Can this man, so devoid of philosophic insight, be the imagined law-giver and prophet of Science—the man who was to do for the nineteenth century more than Bacon had done for the seventeenth—but who, instead, has merely founded a new sect?

On one point Mr. Constable is in error. He says: "Most Comtists believe in Darwin's theories." Not so; like Comte himself, Robin, his successor in the pseudo-papacy, and their followers are adherents of the Old Natural History, G. H. Lewes being perhaps the only exception of moment. Positivism, contrary to what a hasty reader of the "Philosophie Positive" might infer, is not merely unscientific but anti-scientific in its tendencies. It formally boasts of setting limits to the "inroads of Science," and should it ever possess the power, it has the will to take up the *rôle* of her enemy and persecutor. We can forgive Mr. Constable a multitude of sins for his hearty, honest loathing of Positivism and its cant.

John Stuart Mill is also somewhat severely dealt with. He is described as a "sort of a decorous Voltaire, but without the charming wit of the latter." But we think that the author errs in taking either Comte or Mill as types of men of science. They were no such thing. They were essentially readers, men of books and paper, not observers and experimentalists—men of things. It is a great mistake to assume, as does Mr. Constable, that even the "third rate man of science"—an expression repeated more frequently in these volumes than we have time to count—is rendered torpid by analysis. Whenever they meet with moderately fair play, that is, when they are neither burnt at the stake, imprisoned, nor caused to perish for want of the common necessaries of life, they rank among the happiest members of society. In some minds the hunger and thirst for knowledge, for truth, is a consuming passion, quite independently of any advantage which may accrue to themselves from their discoveries or inventions. Only those who have felt this passion can judge of the intense gratification which scientific discovery affords.

What must we say to this passage?—"We often see that the man who works with unceasing brain-work, and does nothing else, though he may learn to perform marvellous gymnastic feats with his intellect, pays a fearfully heavy price. Gradually, as the years pass, he freezes and hardens. Natural affections vanish. His soul, if ever he had one, flies away, and he is left, a piece of wonderful machinery, warm as ice and soft as flint. Still he sometimes does work that the world wants." Here, again, we have proof that Mr. Constable does not know the man of science. Let him look at Darwin, engaged in research and discovery from his youth up to within a few hours of his death. Yet everyone knows that he was kindly, gentle, beloved, and happy in his family circle, kind to the poor, modest, and humble. The author's description may be true of the men who are "reading" for degrees, honours, &c., but it is not true of the men who are "working" for hitherto undiscovered truths.

Concerning spiritualism the author says: "The unexplained facts that come under the heads of somnambulism, hysteria, mesmerism, table rapping, &c., which remain after much imposture is allowed for, cannot be denied by any but the straitest sect of scientific pharisees. But to attribute them to anything but abnormal workings of the mind, or to anything that people think they mean by the term 'spirits,' is, in the present state of knowledge on the subject, simply superstitious." Here, then, we see Mr. Constable firing off both barrels, and hitting Dr. Carpenter on the one hand, and Mr. A. R. Wallace and Prof. Zoellner on the other. But there is some truth in the following passage:—"The way men of science shirk these questions is cowardly in the extreme, and shows that their boasted love of truth is only love of themselves and of their little reputations."

The chapter entitled "A Hint or Two about Faith as distinguished from Knowledge," reminds us of M. J. B. Stallo's "Concepts and Theories of Modern Physics," and also of Mr. H. Griffith's "Faith, the Life-Root of Science, Philosophy, Ethics, and Religion."

The "germ theory" is a pet *bête noire* of Mr. Constable. Perhaps, if he were acquainted with the evidence which has lately come to light, he would alter his opinion.

The following passage is worth quoting:—"What strange creatures men are. They run their sewage into the ocean, and then whine that they have no manure; send their rainfall into the gutters, and then whine that they have no water; keep their cattle in unhealthy conditions, and then whine because they become subject to disease; kill and bury them six feet deep, and then whine because they have no stock for their fields; get higher pay for their labour, and then whine because the price of what is produced by that labour becomes higher: insist on and get equality, and then whine because they have thus lost liberty; quarrel with and prevent the formation of capital, and then whine because wages are less than they think they should be, &c."

This is doubtless ably put, but is not Mr. Constable afraid of being called a pessimist—a class for whom he entertains no great affection? By the way, the name "pessimist" is sometimes applied very illogically. A pessimist surely is not a man who sees and says that there is much evil in the world, but one who, inverting the old superstition that everything is right, maintains that everything is wrong and as far wrong as it can be.

Inconsistency is of course to be expected in a work like the one before us. The author defends field sports from the charge of cruelty. Be it so; not being infected with "zoo-folly," we do not bring that charge, and we fully admit and uphold the necessity for physical culture. But when a sportsman and a champion of sport, thus willing to inflict pain and death upon animals for his amusement, or the cultivation of his own nerves and muscles, ventures to find fault with experimental physiology we are reminded of sundry proverbs not to be quoted in these days.

Were the repetitions and some of the slightly thread-bare anecdotes struck out of these volumes they would become much more readable. In the meantime it is perhaps not unwholesome for "third rate men of science," like ourselves, to learn how we appear from a totally novel point of view.

Portfolios of Drawings and Descriptions of Living Organisms (Animal and Vegetable) illustrative of Fresh-water and Marine Life. Nos. 1 to 8. 1879 to 1882. By THOMAS BOLTON, 57, Newhall Street, Birmingham.

FOR some years past Mr. Bolton has supplied specimens of living organisms for microscopical study, arrangements being made by which they are transmitted by post at periods suiting the requirements of the various institutions and individuals constituting his subscribers. Each tube has been accompanied by a sheet containing a full account of the specimen: these are now issued in a collected form, each portfolio containing about eighteen figures and descriptions.

Respecting the figures they are all truthful, and appear in most instances to be drawn from the objects themselves: when this is not the case the source from whence they are obtained is stated. Although some of the plates are roughly printed, being evidently the work of one of the numerous processes for multiplying copies of writing, and despatched hastily with some specimen unable to bear delay, most are extremely well executed, the whole forming a useful collection for reference, containing figures which would have to be sought for, if published at all, in many costly books and periodicals.

The descriptions, usually on the back of the leaflet, are of great value to the microscopical student, being well adapted to to show the receiver of the specimen what he is to look for,—a needful precaution with a tube containing perhaps a small portion of some plant with numerous all but invisible living organisms attached.

The account is very full, the matter sometimes original; frequently, in the case of a new or rare specimen, a copy of a letter received from some eminent authority to whom it was sent for identification, and here published for the first time, or else an acknowledged quotation from some periodical or book where the description is to be found.

To criticise the collection as works of art would be unfair, as they are put forward with no claim to that distinction, but are rather to be looked upon as notes taken by the side of the microscope, a state in which an observer's thoughts seldom or never reach the outer world. Natural-history papers would often gain much if the author could put his own work upon the stone, although the result might in some respects compare unfavourably with the work of the professional lithographer; yet a greater amount of truth would reach the reader, as, in spite of the greatest care on the part of the copyist, errors of interpretation are inevitable, and high artistic finish is a poor compensation for want of scientific accuracy.

The series, now to be had apart from the distribution of specimens at a merely nominal price, will prove of great value to those microscopists who study living aquatic forms, especially where access to works of reference is difficult, and will be useful in identifying the results of their pond and shore expeditions.

The Geological Record for 1878. An Account of Works on Geology, Mineralogy, and Palæontology published during the Year, with Supplements for 1874 to 1877. Edited by W. Whittaker, R.A., F.G.S., and W. H. Dalton, F.G.S. London: Taylor and Francis.

The delay in the appearance of this volume need not surprise us if we consider the great and growing mass of journals, transactions, and independent works which the editors have to search through. The sections for America and the Arctic Regions, after being long waited for, have not been sent in by the sub-editor of that department, and consequently the volume has been issued without them.

As regards the first division of the work, *viz.*, Stratigraphical and Descriptive Geology, we cannot help being struck with the small space taken up by researches in Asia, Africa, and Australia, as compared with the British Isles and the European continent. This is, of course, no fault of Mr. Whittaker or of his sub-editors. What has not been done cannot be recorded. But why has so little been done? Why is least done where most remains to be done?

The section on Physical Geology contains brief summaries of many of the more important memoirs indexed. Thus we have an abstract of Sir G. Airy's paper on the probable condition of the interior of the earth: the author holds that if the planets have been formed by the condensation of nebulæ, the various parts of such nebulæ must have differed greatly from each other. The Rev. Dr. Haughton, in a memoir on a new method of finding limits to the duration of certain geological epochs, gives the minor limit of geological time at the low figure of 11,700,000 years. Mr. W. T. Travers ascribes the warmer climate of the Eocene period to heat radiated out from the interior of the globe. Dr. Streng, in his "Theorie des Plutonismus," considers that as the initial temperature of our earth fell, an upper light layer of molten acid silicates was formed upon a lower dense zone of basic silicates, whilst an intermediate mixture was formed by diffusion, a continued reduction of temperature forming an outer solid shell: the author supposes that the interior may consist of a solid nucleus, with a series of alternate liquid and solid shells between the nucleus and the outer crust. Mr. A. W. Waters, treating of the influence of the position of land and sea upon a shifting of the axis of the earth, considers that any submarine elevation in the oceanic area would displace the pole along the line 52° E. long.

The section on Palæontology is very extensive. There is a notice of Prof. J. A. Allen's paper on a fossil bird from the Florissant shales (*Palæospiza bella*), the feathers of which have been preserved. Prof. W. B. Dawkins, in discussing the British Pleistocene Mammalia, contends that the lion, panther, and urus are the only three mammals exterminated in Europe in the historic period. "The urus breed was introduced into Britain by the English; the fallow deer marks the influence of the Roman power, and the domestic cat intercourse with the south and east of Europe." As regards the fallow deer a difference of opinion prevails. Mr. Grant Allen, in a work reviewed in our September issue, thinks that it formed a part of our indigenous fauna.

Prof. R. Owen, in discussing the "influence of the advent of a higher form of life in modifying the structure of an older and lower form, instances the changes which have taken place in crocodiles since the incoming of terrestrial mammals. In order to prey upon these, along the brink of the rivers, the fore-legs of the modern crocodiles have become longer and stronger, whilst the palato-nares are removed farther back.

The "Geological Record" is an indispensable requisite in the library, not merely of every geologist, but of the student of animal and vegetable life.

Synopsis of the Classification of the Animal Kingdom. By H. Alleyne Nicholson, M.D., Ph.D., D.Sc., F.L.S., F.G.S., &c., Regius Professor of Natural History in the University of Aberdeen. W. Blackwood and Sons: Edinburgh and London.

The author of this little work has undertaken to give simply a skeleton outline of the animal kingdom. He enumerates the sub-kingdoms, classes, orders, and sub-orders; but he has not found it possible to mention even all the families, much less the genera. A number of illustrations are given which are accurately and clearly drawn, with the exception perhaps of the figure of *Cicindela campestris* (p. 72). Definitions are added only in case of the sub-kingdoms or types.

Among the peculiarities of the author's classification we notice that he retains the two Cuvierian orders "Quadrumana" and "Bimana," including in the former the Lemuroidea. He also adheres to Cuvierian principles in placing the Mollusca above, or at least subsequent to, the Annulosa. At the same time we have no right, and certainly no wish, to accuse Dr. Nicholson of conceiving of the animal kingdom as a single linear succession. In a treatise like that before us the representation of divergent series could not be conveniently presented.

Like all the author's productions, the present work may in the main be conscientiously recommended.

Longman's Magazine. No. I., November, 1882. Longmans and Co.

We have here the first number of a new journal belonging apparently to the same type as the "Contemporary," the "Fortnightly," the "Nineteenth Century," &c. Few of the articles, of course, fall within our special competence. All the papers bear the signatures of their respective authors, according to the modern custom, the British public, it appears, caring less what is said than who says it, and being too slothful to seek out the merits of an article unless enticed by an eminent name.

Prof. Tyndall communicates a paper on "Atoms, Molecules, and Ether Waves," written in his usual clear incisive style. Referring to the celebrated definition of Science as "organised common sense," the writer says that "for the natural history sciences the definition may stand—hardly for the physical and mathematical sciences." We can scarcely accept this distinction. On the one hand, biology has had great difficulty in disentangling herself from organised nonsense, and, on the other, her most recent conceptions seem to the outsider quite as preposterous as do the deductions of the physicist.

"Our Origin as a Species," by Prof. R. Owen, is somewhat disappointing, as being merely negative in its tendency. The illustrious author still recognises the Cuvierian genera of Quadrumana and Bimana. Now we submit that whatever organ has a heel-bone is not a hand, but a foot, and that consequently the order Quadrumana—four-handers—has no existence.

A story entitled "The Black Poodle" may be a satire on dog-worship.

CORRESPONDENCE.

⁂ The Editor does not hold himself responsible for statements of facts or opinions expressed in Correspondence, or in Articles bearing the signature of their respective authors.

A FAILURE IN THE PRODUCTION OF HONEY.

To the Editor of the Journal of Science.

Sir,—Bee-masters in the London district, as well as in Buckinghamshire, Northamptonshire, and other parts of the Midlands, complain that their hives have been this season totally unproductive, and that the bees, instead of having any honey to spare, will require food to support them through the winter. Can this be due to some disease among the insects, to a lack of flowers, or to some peculiarity of the weather ?—I am, &c.,

Apiarian.

EFFECTS OF DARKNESS ON ANIMALS.

To the Editor of the Journal of Science.

Sir,—How is it that mice, though spending their lives in absolute darkness, neither lose their colour nor their eyesight ? They seem to me to have quite as little need of sight as has the mole, yet disuse of the faculty does not seem to lead into degeneration of the organ.—I am, &c.,

C. G.

NOTES.

Sewage Treatment: the Native Guano Company: Agricultural Show at Aylesbury.—On October 19th a numerous gathering of gentlemen interested in Sanitary Reform and in Agriculture took place at the works of the Native Guano Company at Aylesbury. The display of farm and garden produce, vouched as being grown solely with the "Native Guano," or manure, obtained by the precipitation of the Aylesbury sewage, was exceedingly fine, and was pronounced by practical men most satisfactory. The entries were 441 in number, being above a hundred more than at the last year's show. The purification of the sewage is evidently most successful. We find that some of the most determined opponents of sewage precipitation have overcome their former prejudices. Had even the late Royal Rivers' Pollution Commission been present they would have been compelled to own that the entire process, from beginning to end, is totally free from nuisance.

According to the "Medical Press and Circular" Dr. J. B. Mitchell challenges Anti-Vaccinationists to an *experimentum crucis*. He proposes that a duly qualified person on behalf of the Anti-Vaccinationists shall accompany him to some country where physiological experimentation is free, and that a comparison shall be made between the respective results produced by smallpox inoculation of recently vaccinated and unvaccinated persons. The expenses are to be equally borne by both parties at the outset, but as soon as the decision is arrived at the loser is to defray the whole. These proposals we learn have been communicated to Mr. P. A. Taylor, M.P., and to the "Echo," but in both quarters a solemn silence has been observed.

A medical contemporary writes:—"The Society which is so careful of the few animals which suffer under the hands of scientific investigators, whilst it regards unheeding a millionfold greater cruelties daily occurring, is not dead, but stunned." Surely, then, this is the time to press on with its exposure, so that it may have no time or opportunity for revival!

The Corporation of Wigan have been persuaded into disposing of their sewage by means of an irrigation farm, at a cost of £62,000. A claim is now brought against them for £22,664 12*s.* 7*d.* for the value of the coal underlying half a mile of the line of pipe conveying the sewage to the fields. This is a peril of irrigationism which has not yet been taken into account.

The following chemico-physiological hypothesis, in explanation of some presumed supernatural phenomena, has been suggested to us by a friend whose name, pending further observations, we withhold:—

It is all but absolutely certain that the witch-ointments, magic fumigations, &c., used in antiquity and in the Middle Ages, contained ingredients capable of producing delusions, visions of demons, &c., in persons exposed to their influence. It is certain that the use of the Siberian fungus (*Amanita muscaria*) produces similar effects upon those who swallow it. The suggestion is thrown out that microscopic cryptogams, when inhaled, may produce a temporary derangement of the nervous system, during which the patient fancies he sees, hears, or feels unaccountable sights, sounds, and impressions. Our friend states that when travelling he has sometimes occupied rooms in which he experienced a peculiar uneasiness and a disposition to be continually looking round to see if there was not something unpleasant behind him. A cold shudder down the spine was also experienced. In such rooms there was a persistent odour, faintly pungent, like that of an unfrequented library. He considers that, especially in old castles, halls, &c., the walls, furniture, &c., are covered with minute Fungi, the dust of which, if inhaled, may cause symptoms varying from the slight uneasiness which he has experienced to terrifying visions.

M. Clément Lucas publishes a case in which the production of supernumerary fingers is traced for five successive generations. The starting-points of the families in question, a man and a woman, brother and sister, were both free from deformities. The man was a giant who was exhibited as a curiosity. Of his eighty descendants twenty-four have been affected with deformities of the fingers and toes. This is the more remarkable as there have been no consanguineous marriages among his descendants. In the last generations the deformity appears in the males only. It is to be noted that these deformities become more marked the farther we depart from the original stock. The descendants depart farther and farther from the normal type. (This case is very suggestive from an Evolutionist point of view).

The "Scottish Naturalist" records 137 species of Lepidoptera found in the Orkneys, 59 in Shetland, and 62 in the Outer Hebrides. Only 24 species are common to all the three groups of islands. According to Mr. Jenner Weir the Orkney insects scarcely differ from those of North Scotland. The Outer Hebridean specimens are more differentiated than those of the Orkneys, and their prevailing colour is grey. In the Shetland specimens there is a wider variation in colour, and some of the species diverge into well-marked varieties.

Mr. W. Stokes, in an Address delivered at the Jubilee Meeting of the British Medical Association, says, speaking of the Bestiarians, " Their wrath is reserved not for the sportsman, the gourmet, or the military tyrant, but for the physiologist, who is outlawed if he does not fulfil all the vexatious conditions of an extraordinary Act, the passing of which was simply an insult to our profession."

It is not generally known that the autumnal tints of foliage are not produced in regions where the air is polluted with sulphur-fumes. The leaves shrivel up and blacken without previously turning red or yellow.

A healthy young man, of our acquaintance, has been in some danger from the sting of a single bee, received on the side of the nose near the eye. The roof of the mouth swelled, the œsophagus was for some time entirely closed, and breathing became exceedingly difficult.

The Abbé Moigno says that the ancient cubit, the ten-millionth part of the polar axis of the earth, is preferable, as a standard unity of measurement, to the metre.

Dr. Johnston, of New York, maintains that chloroform cannot be given to sleepers without waking them, save by an expert.

The " Annales de Chimie et de Physique " calls attention to a paper on the " Re-concentration of the Mechanical Energy of the Universe," read by the late Prof. W. J. Macquorn Rankine at the meeting of the British Association in 1852.

A statue in honour of the late A. C. Becquerel was inaugurated on September 24th, at Chatillon-sur-Loing, amidst much speech-making. Prof. Dumas availed himself of the opportunity to glorify beet-root sugar, and to pronounce invention a " quality essentially French."

M. Fremy, "following on the same side," asserted that Daniell's constant-current battery ought to be, and would be, called Becquerel's battery.

Mr. St. Croix Rose (" *Zoologist* ") gives, as an eye-witness, a case of a viper swallowing her young. On cutting her open the young were found in the stomach.

Dr. Tholozan (" Comptes Rendus ") in a memoir on the occasional outbursts of plague in Kurdistan, expresses the opinion that the received views on the origin and spread of epidemics, will, in the very near future, have to be submitted to a complete revision.

Every new idea or system, whilst still *sub judice*, is apt to afford shelter and pabulum to a double crop of charlatans; on the one side promoters, on the other side " exposers."

Bee-keeping has this season been a failure throughout most parts of England.

"Les Mondes," in commenting upon the devices of Lahure for preventing collisions at sea, remarks that "in France the fantastic theories of politicians always take precedence of the modest but useful and practical studies of the true benefactors of humanity." In France only?

Anisoplia austriaca, a lamellicorn beetle, has committed this year great ravages in the corn-fields of Southern Russia. It has hitherto resisted all means of destruction.

At the recent meeting of the French Association for the Advancement of Science M. Ayam communicated particulars concerning a case of double-consciousness. A certain Félida X., who has been ill for twenty-three years, has two mental conditions, a normal and an abnormal. In one state she has no recollection of what passes whilst she is in the other.

The death of Frederick Wœhler, for many years Professor of Chemistry at the University of Göttingen, breaks one of our remaining links of personal connection with the science of the earlier half of the century. He was the favourite pupil of Berzelius, and above all his other titles to honour will be remembered as the first chemist who produced an organic compound artificially.

It is strange how the merits of Dr. G. Walker,—"Churchyard Walker" as he was called,—as the father of Sanitary Reform, are ignored. The honour due to him is ascribed to some who shine only by reflected light.

The "Medical News" considers that Carlyle's philosophy was in a great measure the outcome of acid indigestion and flatulence.

According to "L'Union Médicale" there are no rats in the Polynesian Islands, though attempts have been made to acclimatise them, as a favourite food of the natives. Why should they be less able to thrive here than in Mauritius, which has a very similar climate?

The "Boston Journal of Chemistry" notices the extreme tenacity of life shown by weeds and noxious animals.

It is said that the Zulu "medicine-men" who accompanied their sovereign on his late visit to England, when shown rhubarb and ipecacuana,—drugs which are not likely to grow in Zululand,—at once described them as respectively a purgative and as a great vomit-root." Such instinctive knowledge, if shown, *e.g.*, by an ape, would have been the theme for much stilted declamation.

According to the "Salina Journal" (Kansas) a hailstone weighing 80 lbs. (!) was recently found near Salina. Many others, weighing 4 or 5 lbs. each, are said to have fallen on the same occasion.

It is said that only man, the goat, and the wild Carnivora are able to resist the poison of the African tsetsé fly. The supposed immunity of the ass is unfounded.

According to M. Daubrée ("Comptes Rendus") earthquakes have probably their maximum at the new and full moon, and their minimum at the intermediate quarters of the lunation.

The family of the late Prof. Balfour have presented his scientific library to the University of Cambridge for the use of the Morphological Laboratory. A memorial to the dead is in contemplation, but whether it will take the shape of a monument, a scholarship, or a prize for morphological research, is still undecided.

The Victoria Street Bestiarians have issued a reply to Prof. Owen under the absurd title "The Coward Science." To compete with this body either in illogicality or abusiveness would be a hopeless task.

We learn that a literary journal in the Irish tongue will shortly be issued. We wish it success, as every language is an important piece of ethnological evidence, and as such worthy of preservation. It is to be regretted that the ancient Cornish tongue was allowed to become extinct.

Intimations reach us that the "Salvation Army" is to be counted on as hostile to Science in general, and to Evolutionism in particular. Organised ignorance is, even in these days, a power not to be despised.

Prof. Stokes is reported to have said, at the recent Church Congress at Derby, "I prefer resting in the statement of a special creation, without prying into its method." Is this a scientific attitude?

Our worthy contributor Prof. R. Galloway will, like Sir H. Davy, earn the title of a "vera troublesome person in chemistry." He is calling attention to the necessity of adding phosphate of potash to salt meats, as a preventive for sea-scurvy. But officialism clings to lime-juice.

Prof. Galloway has also pointed out the great facilities for obtaining iodine, bromine, and potash from sea-weeds on the west coast of Ireland.

The "American Medical News" chastises Miss F. P. Cobbe for an attack on the medical profession. The "Medical Press and Circular" expresses the hope that "our Transatlantic friends will not be misled into attaching very serious importance to what Miss Cobbe's prejudices may lead her to express."

The "Lancet" remarks that "to the intelligent student of the medical sciences Berkeleyism supplies the only key that will unlock a world of mystery."

The new Chair of Anatomy and Physiology in the University of Sydney is to be held by Dr. T. P. Anderson-Stuart.

It is announced that a Lecture on "Healthy Motherhood" is to be delivered during the ensuing winter before the Young Men's Christian Association of Glasgow.

Sweeping charges of cowardice are being brought against the London press for having wholly or in part "suppressed" a certain letter from Charles Darwin to a student at Jena. How many scientific or philosophic journals have had the option of "suppressing" it?

MM. Dehérain and Muntz find that nitrates in arable soils are reduced by anærobic organisms, which thus play an inverse part to the ærobic microbia which are the agents of nitrification.

EIGHTEENTH YEAR OF PUBLICATION.

THE

JOURNAL OF SCIENCE,

AND ANNALS OF

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BRITISH MUSEUM NATURAL HISTORY

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THE
JOURNAL OF SCIENCE.

DECEMBER, 1882.

I. LITERATURE *versus* SCIENCE.

THE external or foreign relations of Science are not at present free from tension. The religious world still looks upon her position and her claims with distrust. Politicians begrudge her the share of attention which she receives from the public, as calculated to lessen the interest in agitations and "movements." Zoo-folly and Bestiarianism seek to arrest her further development in one of the most important directions. Last, but not least, Literature views her with a dislike and a jealousy which cannot be concealed. We have frequently met with expressions of this dislike on the part of historians, poets, and the like, and we have occasionally quoted such outbreaks in the "Journal of Science." Some of our readers will, perhaps, remember that a Mr. E. R. Russell, in a paper read before the Literary and Philosophical Society of Liverpool, took occasion to characterise Science as "blind and groping physicism." Sayings equally uncomplimentary might be cited from Carlyle, Ruskin, and other eminent modern writers. But the feelings of the professed literary world towards Science have been latterly expounded with much clearness and force in the "Rede Lecture" delivered before the University of Cambridge. The lecturer, Mr. Matthew Arnold, is well known as a powerful, brilliant, and admired writer. We can cheerfully admit that he has put before the English public certain lessons which, be they accepted or not, are of no small value. But as regards the question at issue we are bound to submit that he has utterly misapprehended, and consequently misrepresented, the position, the scope, and the aims of Science.

Mr. Arnold says that ten years ago he "could not help being moved with a desire to plead with the friends of physical science on behalf of letters." These very words reveal one of his cardinal mistakes. He might as well plead with the Poles on behalf of Russia, or, going back a few years, he might as rationally have pleaded with the Italians on the part of Austria, or with the Abolitionists of New England in favour of the Slave system! The question lies in a nutshell: Science is fighting for liberty, Literature for dominion. We have been living in a state of bondage which even yet is far from having come to a complete end. In how many schools is Science placed upon anything approaching to an equality with classical studies? In which of our universities can a man devote his whole time and energies to the knowledge of Nature? In Mr. Arnold's own University, Oxford, the student whose aim in life is to qualify himself for research—*e.g.*, in biology—has first to pass "Responsions and Classical Moderations," which will take up his attention for a year. When the Yorkshire College was instituted it was, indeed, first planned and named as the "Yorkshire College of Science"—whereupon there arose a loud clamour from those whom Prof. Huxley happily designates as the "Levites of culture." A college for Science alone was, they cried out, a "one-legged affair"; Literature must be added! Strange that they never felt or saw any "one-leggedness" in the many schools and colleges where, till lately at least, Science was totally excluded! In the case of the Yorkshire College the friends of Science yielded. And it was not until Sir Josiah Mason's munificent endowment, in Birmingham, that we have been able to point to at least one institution where those who desire to study Science alone may find themselves at home.* To the foundation of this College and to Prof. Huxley's inaugural speech we owe Mr. Arnold's counter-demonstration at Cambridge.

But we need not enlarge further upon the position of inferiority and restriction in which we find ourselves placed, and which Mr. Arnold naïvely "pleads" with us to accept and endure! Let him plead never so eloquently and subtly we cannot accept it without being false to ourselves, to the world, and to our duty. We claim for Science full freedom, and an equality with "letters" in all educational institutions. This demand involves that classical knowledge shall not be demanded from the student of Science at any point of his career, and that in examinations for scientific degrees and honours it shall not be introduced even as an optional subject. But we do not demand the abolition or restriction of literary pursuits. The " poor humanist," as Mr. Arnold calls himself and his fellow-believers collectively, may, as far as our wishes and aims are concerned, go on for ever pondering on " longs and shorts," writing "nonsense-verses" at school, and commenting on Homer and Sophocles in after life. Nor would we force our pursuits upon him. The world is wide enough for us both ; let him go his way, and we will go ours. But let him remember that we cannot, dare not, tolerate his assumptions of superiority.

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* Sad that this College should in one direction have barred the door against research.

What is the nature of Mr. Arnold's plea on behalf of that predominance for which he is contending ? He tries to show that Literature includes Science. " Literature," he says, " is a large word ; it may mean everything written with letters or printed in a book. Euclid's 'Elements' and Newton's 'Principia' are thus literature. All knowledge that reaches us through books is literature." But this is not the sense in which " literature " is understood either by the friends or the opponents of its past educational supremacy. It is not the sense in which it is used by Mr. Arnold himself in the very lecture before us. For he says—" My own studies have been almost wholly in letters [a synonym for literature], and my visits to the field of the natural sciences have been very slight and inadequate." Here, in fact, he admits the distinction which he has just been calling in question. That distinction is, indeed, felt by all educated men, however little they may be able to point out the basis upon which it rests. No one would rank the " Elements " of Euclid, or the " Physics " of Aristoteles, among Greek literature in the same sense as he would the writings of Homer, of Thucydides, or of Plato. No one in a dissertation on the characteristics of English literature would take into consideration either the " Principia " (which, by the way, was written in Latin) or the " Origin of Species." The value of these two works lies not in themselves, but in the facts which they communicate, and in the conclusions they draw from these facts. Were every copy of the " Principia " or of the " Origin of Species " destroyed, Science would be no loser, since their teachings have been incorporated into an ever-growing body of truth. But with what are commonly and properly called literary works the case is totally different. The value of the " Paradise Lost " or of "Hamlet" is not absorbed and incorporated, but remains in themselves, and hence their destruction would be a permanent loss to literature. But there is another great distinction between Science and Literature which Mr. Arnold has overlooked: Science, if learned at all, is learned not so much from books as from things. By it, and by it alone, we learn the art of observing things and of understanding their mutual relations. Hence the distinction between Science and Literature is world-wide: they are in some respects incommensurable, and any attempt on the part of the latter to dominate or to include the former must lead not merely to hostility, but to results disastrous for the individual and the race. Nay, if a claim for supremacy and inclusion is allowable at all, it might be more rationally inverted. If we wish to know nations and their languages, even the idolised Greek tongue, we shall do well to reflect that such knowledge is but a very subordinate portion of ethnology, which is a portion of anthropology, which is a mere fragment of biology! It is interesting for the biologist to look down and see such a presumptuous mutiny in a corner of his domain,—a parish aspiring to comprehend and exercise supremacy over the affairs of an empire!

The literary opponents of Science speak much of human nature and its wants. But man can be rightly studied only in connection with the organic world of which he is a member, and with the earth upon which he lives. This Science does at least approximately; "letters" cannot even make the attempt.

Mr. Arnold puts forward with some iteration, but hardly, we venture to say, with sufficient clearness, a consideration which he thinks explains "the strength of the hold which letters have upon us." He says—"We acquire pieces of knowledge, and presently, in the generality of men, there arises the desire to relate these pieces of knowledge to our sense for conduct, to our sense for beauty, and there are weariness and dissatisfaction if the desire is baulked."

Or again:—"We feel, as we go on learning and knowing, the vast majority of mankind feel the need of relating what we have learned and known to the sense which we have in us for conduct, to the sense which we have in us for beauty."

These phrases, "sense for conduct" and "sense for beauty," are the burden of Mr. Arnold's song. They recur again and again, as do the words "sweetness and light" in some of his former writings, Now a clever catch-word may possibly overturn a throne, but it cannot decide a philosophic question.

Here Mr. Arnold falls into a sin of omission. Any new piece of knowledge men desire, in the first place, to correlate with their necessities. This will be so as long as "nineteen-twentieths of mankind have to ask—not 'How shall we live?' but 'Can we live at all?'" This, Dr. Beard tells us, is the case in America; and in Europe, in face of the continual stream of emigrants from it to the United States, human condition cannot be supposed better. Now certainly to these nineteen-twentieths Literature has nothing to offer: she never has made two blades of grass grow where one grew before, and she never can or will in the future: she never slew a fever-germ or a noxious insect,—never warned us of an approaching tempest.

If we turn from the many to the favoured few who have time to ask "How we shall live?" we find Mr. Arnold is guilty of another omission. There is in man a sense for truth, quite as strong as the "sense for conduct and the sense for beauty," of which the lecturer makes such frequent mention. To this sense we naturally and instinctively relate every new piece of knowledge which we acquire. Is it true? If true, what is its place in the knowledge which we already possess? What can we further infer from it? What theories does it confirm or infirm? These are the questions which we naturally ask. Men as a body do not seek to correlate any scientific knowledge they may acquire with their "sense for conduct." Their "conduct," if we are to understand by that their habits and character from a moral point of view, is for the most part determined by heredity, by early training, by the example of friends and neighbours, by the presence of public opinion, and is not influenced by the state of their scientific attainments. Suppose that to-morrow half the so-called elements of chemistry were to be resolved into still simpler bodies, would anyone seriously set out on the wild-goose chase of seeking to correlate this result with ethical principles? That both ethics and æsthetics may perhaps be found to have their root in biology is possible, but "letters" certainly will not be the finder. It is doubtless true that the love of knowledge for its own sake is not the ruling passion with the majority of mankind; the many love it, if at all, for its utilities. But if Science is to a great number of people wearying and unsatisfying, does not this depend in many cases on the nature of their education, which appeals more to the passions and the emotions than to the intellect?

Mr. Arnold, after mentioning Darwin as one for whose mental cravings "Science and the domestic affections were enough," remarks—"But then Darwins are very rare, Another great and admirable master of natural knowledge, Faraday, was a Sandemannian. *That is to say, he related his knowledge to his instinct for conduct and to his instinct for beauty by the aid of that respectable Scottish sectary Robert Sandemann.*" Now the assertion conveyed in the sentence we have italicised must be distinctly denied. Faraday was a Sandemannian, and he was an illustrious man of Science. But between his Sandemannianism and his marvellous discoveries in electricity there was no relation beyond co-existence. Indeed, unless our memory has greatly deceived us, Faraday declared, almost *totidem verbis*, that he had never sought to bring his scientific attainments into correlation with his religious faith. Either might have existed without the other.

It would almost seem as if Mr. Arnold fears a decline, ethical and æsthetical, if literature—and especially Greek literature—is deposed from its usurped position in our educational establishments. This may seem strange if we remember that the morals of that part of the nation which is void of every tincture of classical learning are at least as pure as those of the "poor humanist." If the teachings of the Greek philosophers are worn-out garments which have fallen off from the expanding form of truth, the lays of their contemporary poets are equally unfit for the youth of the present day.

Nor is it otherwise with our sense for beauty. Has it never struck Mr. Arnold that in England, the very country where classical studies have been most predominant, the love of the beautiful is feeblest? Symmetry? We may find it brighter and purer in crystals and shells, in flowers and insects, than in Greek grammars. Those who have never studied the Greek language, and those who have gladly thrown it aside as an encumbrance, can see the meanness of our modern street architecture without looking through the dim lens of classical antiquity. Neither for the right guidance of our actions nor that we may have a love for the beautiful do we need the aids of Greece and Rome. They and their humane letters cannot—simply cannot—"establish a relation between the new conceptions and our instinct for beauty, our instinct for conduct." In as far as such relations are conceivable they will be evolved to suit the changed conditions.

Mr. Arnold even endeavours to defend mediæval education against the just scorn of Prof. Huxley. As his defence ends with the usual refrain it may be left to the imagination of the reader.

One passage, however, we must still quote. Says Mr. Arnold:—"I have in my mind's eye a Member of Parliament who goes to America, who relates his travels, and who shows a really masterly knowledge of the geology of the country and of its mining capabilities, but who ends by gravely suggesting that the United States should borrow a prince from our royal family, and should make him their king, and should create a House of Lords of great landed proprietors after the pattern of ours; and then America, he thinks, would have her future happily secured. Surely, in this case, the President of the Section for Mechanical Science would himself hardly say that our Member of Parliament, by concentrating himself upon geology and mining, and so on, and not attending to literature and history, had 'chosen the more useful alternative.'"

To this facetious apologue we reply by reminding Mr. Arnold of a certain English official, well versed in literature and history, who sent out a supply of Thames water for the use of a flotilla which we had upon Lake Erie, some seventy years ago, and who, further, when the war was over, ordered the said flotilla to sail home—down the Falls of Niagara—to be paid off at Portsmouth. The error of this official—a serious and embarrassing one—springs directly from his lack of natural knowledge. On the other hand, the error of the Member of Parliament, in itself a harmless blunder, of no consequence, would not necessarily have been obviated by classical and historical studies.

Mr. Arnold may believe that he has made a satisfactory reply to Prof. Huxley. We can merely regard him as an able advocate doing his best for a thoroughly bad cause. If he is pleading with the friends of physical science the verdict cannot be in his favour.

II. A THEORY AS TO THE ORIGIN OF THE SOLAR SYSTEM.

By R. Lamont.

IN the beginning " the earth was without form and void," or, in other words, there was matter but no motion. To this *dead* matter motion was *given*, when it immediately became as it were a thing of life; atom whirled round atom, and, as the outcome of the action of motion upon matter is attraction, atom clung to atom, and molecule rushed towards molecule, to form the nuclei of future worlds. Everywhere these nuclei went spinning round, forming vast whirlpools* in their efforts to gather up as much matter as their fellows, but, owing to difference of speed and proximity of material, all were not alike successful. There were some tiny masses furiously whirling away, in their vain endeavours to overtake their more bulky companions, who had already swept up everything within their reach, and were now striving to draw their little friends within their grasp, but, owing to these smaller masses being endowed with a rotary motion round their own axis, the only effect which the attraction of the larger masses had on them was to convert part of their rotary motion into centrifugal force, which conversion had not only the effect of balancing the attraction, but also of swinging the satellites into the same plane as their primaries.

While this was going on among the comparatively smaller bodies, in our own system there was one huge mass which had already sucked all the surrounding matter within its mighty vortex, and was now seeking to bring these rival systems within its powerful influence; but, as satellite was rolling round planet, and planet was spinning round on its axis, it had no longer to deal with the infinitely small particles of which it had just been built up, but with masses composed of the same material and endowed with the same motion as the Sun himself. He tried to draw them in, but as his attraction diminished with distance, and as the bodies on which he was exerting his attractive power possessed considerable magnitude, the attraction was much greater on the near than on the further side of each individual planet; the effect of this, combined with their rotation, being to cause them to fly off at right angles to the attracting power, but still held by the attractive influence they were swung to the same plane, and rolled round the sun as a centre.

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* *See* Spiral Nebula in Canes Venatici.

If the whole had ended here, and the planets been destitute of the power to increase or diminish the sun's attraction, the retarding influence of such attraction would have gradually overcome centrifugal force, and the planets would have been gently swept on to his surface, the whole matter of the Universe thus ultimately coalescing into one monster mass, which, being no longer acted on by external matter, would have eventually returned to that void from which it sprang. But such was not the case; each planet, as it was added to our system, increased the sun's attraction, enabling him to stretch his influence still further out, and bring within his sway the more distant worlds. Attraction was increased, but so was motion; the fight between attraction and centrifugal force began, the core of our huge dynamo-machine became covered with a brilliant shroud, and the Sun shone out in all his splendour, radiating his light in every direction, as it were in payment of the force expended to maintaim him in his glory.

Along with these formations and arrangements of new worlds there were at the same time small bodies, which, at the balancing of the more important masses, were situated midway between two contending powers, one of which for a time got them within its influence. Their speed, at first slow, gradually went on increasing as they got nearer to the attracting body; and as they were almost destitute of centrifugal force, owing to their having two centres of revolution, they appeared to be driving right on to the surface of the sun. Faster and faster they rushed along, until it almost seemed as if the puny masses were destined to overturn the equipoise of our system. But a sudden change took place; the comets had reached the region of contending forces, attraction was immediately changed into repulsion, and they swept round their huge relation uninjured by his power. Out into space they went, throwing off their bright trappings as they neared their starting-points, there to set out on a new pilgrimage, through other systems and round other suns.

The chief use of the comets in the celestial mechanism is to hold system unchangeably separated from system, so that the motion of the one shall not in any way interfere with the correct working of the other. If some kind of stay had not been provided all would have been confusion; system would have contended with system, and planet with sun. But there is none of this. Far out in the confines of space we find the same regularity and completeness as in our own system, even these anomalous bodies, the variable stars, with their ever-changing brilliancy, being but the product of this action of motion upon matter.

III. DOMESTICITY IN ANIMALS.

AMONG the questions for which the naturalist is expected to have a stock of answers neatly cut and dried, one of the most frequent relates to the domesticity of animals. Why, it is asked, has man succeeded in taming certain species and not others? The querist is not always satisfied to be told that such animals as are likely to be useful to man have for the most part been brought to take their place in human civilisation, whilst those which were dangerous or useless have been left outside, and are treated as enemies. He may, on further reflection, ask why the aborigines of the western hemisphere, at the time of its first discovery by the Spaniards, seem to have had no domestic animals at all, whilst nations of the eastern continent not further advanced in civilisation had enjoyed the services of beasts of burden from a date far anterior to the dawn of history. There is perhaps no feature in the institutions of the ancient Mexican empire more startling than this: that the tasks which in the Old World fell to the lot of the ox, the horse, the ass, or the camel, there devolved upon human beings. A peculiar caste of men, trained to the task and doubtless possessing hereditary powers of speed and indurance, carried intelligence between different parts of the empire. Another caste, the Tamemes of the early Spanish explorers and conquerors, bore merchandise upon their shoulders.

The ancient Peruvians had one only domestic animal, the Llama, adapted by its habits and constitution merely to mountainous countries.

The followers of Swainson seek to explain such anomalies in a somewhat peculiar manner. They argue that all animals capable of domestication belong to their so-called "Rasorial type." Swainson himself writes :—"It seems to have been ordained by Almighty Wisdom that there should be one type above all others whose powers were to be more especially devoted to man, and which should evince an aptitude and a disposition to submit to his dominion far above all other created things. This is the grand characteristic of all rasorial types among the more perfectly formed vertebrate animals, whose size or structure are in any way adapted to answer the end proposed. . . . The ungulated quadrupeds (*Ungulata*) and the rasorial order of birds which show the highest intelligence, the greatest docility, and the most cheerful contentment under the domestication of man. . . . All our quadrupeds of burden or of food are taken from the *Ungulata*. . . . The dog is a rasorial type of the *Feræ*. . . . The common duck, though a natatorial bird, is yet the rasorial type of its own family. . . . The hymenopterous order of the winged insects is, in its own circle, a rasorial type, and we thus find that the ants (?) and the bees, the most useful insects to man and the most intelligent and social of annulose animals represent the ruminating quadrupeds and the gallinaceous birds."*

We are thus to learn that certain animals have been divinely pre-ordained for domestication. These, accordingly, man has succeeded in taming, whilst if he has attempted the subjugation of any other species he has failed.

We will not in reply call in question Swainson's entire classification of animals, built as it is upon outward structure only, and with an avowed disregard of internal anatomy and of embryology. Such a criticism would take us too far, and would in these days be a mere re-slaying of the slain. On this point we will merely remark that it was perfectly easy for Mr. Swainson, by his representative system, to refer a species to any type or "circle" which happened to be convenient.

We will in our reply adhere to plain facts. If the Rasores and their representatives have been especially adapted for domestication, why do so many of them remain outside the pale? We may take as an instance the common pheasant and certain allied species. These birds undoubtedly belong to the order *Rasores*, and even to the same family which includes the common fowl. The delicacy of their flesh has been a strong inducement to man to reduce them to complete domestication, so that they could be bred in the poultry-yard without the costly formalities of "preserves" and game-keepers. But no! So far they still remain half wild; and though they may show some attachment to the person who feeds them, yet on the approach of a stranger they show none of the confidence of the domestic fowl, but at once flee for shelter to the nearest thicket.

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* W. SWAINSON. Geography and Classification of Animals (in Lardner's Cabinet Cyclopædia), p. 258.

Here then we see that human effort, under strong inducement, has failed to domesticate a bird nearly allied to our ordinary poultry! What may take place in the course of successive generations cannot be foreseen.

Turning again to America, we may ask why none of its aborigines had succeeded in domesticating the turkey? With us, and with the white settlers across the Atlantic, it has proved itself quite susceptible of tameness. Were not the Mexicans sufficiently civilised to make so natural an attempt?

Further, why was the American bison (erroneously called buffalo) never brought into subjection by the Red Indians? It would have been of great service to them as a beast of burden as well as for food. It is unquestionably a member of the *Ungulata*, a ruminant animal, and thus belongs to the above-mentioned "rasorial" type. Mr. Swainson, who always can find a way of escape, says:—"Let us first look to that (the genus) of *Bos*, where we have the ox and the bison actually following each other in close affinity, and yet no two animals in their moral character can be more opposite: the one is the most useful, docile, and tameable of the brute creation, the other wild, revengeful, and showing an innate detestation of man. The ox is the typical example of the genus, the bison is the sub-typical." Hence we are to believe that the Red Indians did not tame the bison because he is untameable.

Mr. Swainson is here, as not unfrequently, at issue with facts. The bison, even when wild, shows no disposition to attack man unless molested. He is, indeed, far less dangerous than the half-wild cattle of Texas, of the Andean Paramos, or of the Falkland Islands. The "docility" of *Bos taurus* is, indeed, confined to the female sex. To an unarmed man in an open country there are few animals more dangerous than the common bull; and if he is above four years of age, he is exceedingly given to indulge in unprovoked attacks.*

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* The pugnacity of the bull was no doubt useful when he had to defend his family against wolves. But in a country like England it is surely the duty of cattle-breeders to attempt the development of a more peaceful strain.

But to complete Mr. Swainson's discomfiture, the bison has been found and reported by the most eminent authorities in America to be readily susceptible of domestication.* There is little inducement to multiply the tame breed on the large scale as the cows are not good milkers. But in the absence of ordinary cattle they would be of great value. It must, therefore, remain a problem why the Red Indians did not have herds of tame bison just as the Tartars of the Asiatic steppes have their oxen. The fault evidently lay with them rather than with the bison.

Mr. Swainson's rule concerning the pre-ordained capability of certain animals for tameness breaks down in another direction. Of the carnivorous animals which enter into general domestication, viz., the dog and the cat, he pronounces the former to be the rasorial type of the carnivorous circle. But he does not venture to refer to the cat. This animal is assuredly one of the typical forms of the Carnivora, and hence according to theory, it should be hostile to man. Yet no creature show a greater craving for human sympathy. This is the more remarkable as it is not a gregarious or social species, and even in a state of tameness shows no marked liking for the companionship of its own kind. Two mature cats of the same sex seldom meet each other without muttering an execration. How strikingly different is this from the behaviour of dogs among themselves! That an animal so unsociable to its fellows should not merely tolerate but desire human society is very singular. Most singular it must seem since our domestic cat has been less modified by civilisation than most tame animals, and if circumstances require, can resume her place in the wilderness with more ease than any other tame species. Another peculiar circumstance is that several nearly allied forms, including the wild cat of Britain, seem hitherto utterly untameable though certainly belonging to the same type as *Felis domestica*.

We do not know whether it will be considered a blameworthy digression, but it seems to us and to not a few other observers that the moral character of the cat has altered for the better, and is still altering within say the last century. There are few persons now given to studying closely the habits of animals who would join in those sweeping charges of treachery, selfishness, and ill-temper which were brought against her by earlier writers. Perhaps she has been maligned because of her unwillingness or incapacity to be an accomplice in human vices and follies.

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* J. A. ALLEN. History of the American Bison, p. 585.

Mr. Swainson, before pronouncing the dog the rasorial type of the *Feræ* (*Carnivora*), might have done well to inquire whether this animal is an original and unitary species at all or rather an artificial blend of several wild Canidæ. It might also be asked whether some of these Canidæ, especially *Cuon dukhuensis* and *C. primævus*, have not as good a right as the domestic dog to be considered as a "rasorial type" of the Carnivora? Yet they show none of the same attachment to man which the common dog exhibits; and though they have been occasionally employed in hunting, no dependence can be placed upon them.

There is another carnivorous animal which has never been introduced into Europe, but which in India and China has been for thousands of years a trusted household friend of man, and which for combatting the serpents and other dangerous vermin of hot climates is much more useful than either the dog or the cat. We refer to the so-called ichneumon and mungus (*Herpestes ichneumon* and *H. griseus*), which are two species alike in their habits. One of these creatures is often in India left to guard a sleeping infant in the absence of the mother, and will destroy any snake, scorpion, centipede, &c., which dares to approach. Yet this docile, intelligent, and faithful creature belongs to a group approaching very closely in structure and habits to the Felidæ, and having semi-retractile claws.

Another and quite different attempt at generalisation is conveyed in the assertion that all domestic animals are naturally gregarious. In the majority of instances, both among birds and mammals, this is decidedly true, the cat and the mungus (?) being the only exceptions. But we cannot affirm conversely that all gregarious animals have entered into domestication. The wolf, zebra, the different species of baboons, the hyænas, and various other forms might here be named.

A further very curious observation is, that all the truly domesticated species, both of birds and mammals, are polygamous, or at least promiscuous in their amours. We have here the only point of difference in habits between the ordinary tameable inmates of the farmyard and the pheasants. The common cock, the turkey, the guinea-fowl are feathered Mormonites, whilst the pheasant adheres to one mate. Among mammalia the case is quite similar. The ox, the sheep, the goat, the horse are all polygamous, whilst the cat and the dog form no permanent connections, the nurture and defence of the young being left to the female alone. On the other hand the fox, which lives in pairs, has not become domesticated, and the same may be said of the majority of the monkeys.

But here, also, the attempted rule breaks down on further scrutiny. The pigeon and the various species of parrots are monogamous; yet the former lives contentedly in a state of tameness, and shows a certain degree of attachment to man. Parrots, if kindly treated and not startled by sudden noises and abrupt movements, must rank among the most docile and affectionate of creatures, and have been known to die of grief if separated from their owner. This is the more striking as in their case domestication is the result of a single life-time. We have not been able in Europe to have either the African grey parrot, or *Chrysotis amazonica*, breeding in captivity. This result could doubtless be obtained in a hot climate, and it would be very interesting to note to what extent such birds would acquire the use of human language.

Another exception is of a different character: the gorilla is said to be polygamous, yet he has hitherto resisted all attempts at domestication.

Having thus set aside all these attempts at finding a law for the tameability of animals, we submit that the truth is much simpler than any of them. Any species can be tamed if the attempt is made judiciously and with sufficient perseverance. But in a majority of cases many generations must pass before the original wild nature is permanently and completely subverted by use, that second nature. It is curious that this view was put forward by St. James,* and was doubtless the opinion current in his time.

Whether in any given case the attempt to tame a species is made in a proper manner depends on such a number of considerations that the total result may, in common speech, be termed accidental.

We have yet to point out that there are at least three different grades in what is called the domestication of animals; or, in other words, the degree of relation into which they enter with man. In the lowest grade we find creatures which seek his near neighbourhood, not for the sake of plundering him, as do sparrows, mice, and rats, but for safety. Such are the stork, the swallow, and the martin, the rook, &c. Many more harmless and useful species of birds would enter into this class if nest-robbing, shooting, and trapping were put under a due restraint.

In the second grade come those species which are the property of men and which display a certain kind of docility, but which do not enter into companionship with man. Here we have all kinds of poultry, cattle, &c. The horse, if kindly treated, may pass into the third grade.

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* Epistle III., v. 7.

In this highest class the intimacy is closer. The animal is not merely the chattel but the companion and friend of its owner. Here we have only the dog, the cat, the mungus, the parrot, and a few song-birds.

It is a curious fact, first pointed out, we believe, by Mr. Bartlett, of the Zoological Gardens, that no ruminant animal can be admitted into this class. Pet lambs, kids, calves, fawns, &c., invariably grow vicious as they reach maturity, and have to be consigned to the butcher.

IV. THE CREMATION QUESTION.

By Frank Fernseed.

THERE are still many persons living who can remember the London graveyards, worse far than any Augean stable of old. They can tell us how Dr. George Walker, single-handed, grappled with this monstrous evil, and how, in the very teeth of misrepresentation, calumny, official and parliamentary obstruction, and, worst of all, public apathy, he finally triumphed. They can also perhaps tell us by what legerdemain his claims as the father of modern sanitation have been ignored, and the honours rightfully his have been transferred to others.

But the very same question which called forth the energies of "Churchyard Walker," as he was familiarly called forty years ago, is offering itself afresh to us of the present generation.

Out fathers closed the City churchyards, and laid out burial-grounds in what were then open districts, though at an accessible distance from London. For a time all went on satisfactorily, and many worthy people thought, and possibly still think, that the disposal of the dead was finally settled. But London since the formation of the cemeteries, whether proprietary or parochial, has continued to grow, and these once retired and rural spots are rapidly becoming suburban, and almost urban. Abney Park, Nunhead, Highgate, Kensal Green are now populous regions, and even Finchley sees the speculative builder approaching nearer and nearer to its vast extent of graves. It is therefore plain that the resting-places of the dead will perhaps, even by the end of the present century, be closely surrounded by the dwellings of the living. We shall thus have a repetition of the evils which Dr. Walker devoted his life to banish. True these cemeteries, as far as I understand, can never be so overcrowded as were the old churchyards. Men will not be seen under cover of the night conveying away loads of half-decomposed humanity, and shooting it into the Thames. A grave, when once it has received its stipulated number, will not be reopened to make way for fresh interments ; nor will the distance from grave to grave be reduced. But in spite of these redeeming features the new cemeteries will differ from the old churchyards in degree, but not in kind. Many of them are situate on eminences. Their drainage must and will find its way through the soil to houses built on the lower grounds in their vicinity. Such drainage, containing both septic poisons and disease-germs, must either permeate the soil or find its way into the system of sewers. Neither alternative is pleasant to contemplate. In the former case the ground will be poisoned, and the ground-air also. This ground-air, as Prof. von Pettenkofer has so clearly shown, passes up into our houses according to the changes of barometric pressure and the fluctuations of moisture and of temperature.

If we suppose that such drainage is entirely conveyed into the sewers, the final result is little different, since the water-closets, sinks, &c., all traps notwithstanding, give the sewer-gas access to our houses.

Nor does the air escape pollution from the immense mass of animal matter which is decomposing around us. If we take the population of London at four millions, and estimate the average life of a generation at thirty years, and the mean weight of a human corpse at 56 lbs., we reach the startling result that year by year 3000 tons of animal matter is placed to putrefy in the neighbourhood of the metropolis. Much of this matter contains the germs of smallpox, diphtheria, fevers, occasionally cholera, and other communicable diseases. This, surely, is a serious consideration. How long a lapse of time is required to convert this deadly matter into harmless mould I cannot make bold to say ; but we are I think warranted in supposing that fully ten years must pass over before the buried bodies can cease to be a peril.

Hence, at any given moment, we have around us not merely 3000, but 30,000 tons of dangerous matter.

Some authorities, indeed, contend that the superstratum of earth is a sure safeguard against the escape of any harmful matter from the putrefying corpse below. Whilst fully admitting the great absorbing and purifying quality of the soil, I can see here no pledge of absolute safety. I have in more than one of our cemeteries, in calm weather, detected an unholy smell, though were I to give full particulars I should doubtless find to my cost that "the greater the truth the greater the libel." I have recognised the same unpleasant odour in dull, damp, autumnal evenings, even outside the fences. But, what is much more to the purpose, M. Pasteur, in the course of his prolonged and admirable researches on the propagation of zymotic disease, has noticed that sheep, grazing on ground where victims of the cattle-plague had been buried, became infected. He suggests that earth-worms bring up the morbific matter to the surface. When once there it may easily be disseminated by those ubiquitous *colporteurs* of disease, the flies. M. Pasteur proposes that cattle which have died of anthrax should be buried not in clayey ground, but in calcareous soils, where earth-worms are rare. Unfortunately such soils are scarce in Middlesex.

But to return: if the bodies of oxen, buried beneath 1½ or 2 yards of clay, may still impart disease to creatures feeding or resting on the surface of the ground, there is good reason to fear that human remains will be in like manner hurtful. We have therefore no shadow of reason for expecting that the neighbourhood of our cemeteries, when once fairly "built in," will be healthy.

What, then, are we to do? We cannot set bounds to the spread of London, or enact that no house shall be built within a given distance of the cemeteries. If we did so decree our task would be endless, for the abodes of the dead, like the dwellings of the living, constantly require extension. If houses do not come to the cemetery, it will come to the houses.

Indeed, if we leave the prospect of nuisance entirely on one side, we shall find here, in the mere necessity for the constant enlargement of our burial-grounds, a difficulty of no trifling weight. Can we, as a nation, afford to withdraw a constantly increasing portion of our most valuable lands *for ever* from all remunerative purposes? We are justly dissatisfied when we see acres of land covered with the "spoil-banks" of the coal-owner, the slag-mounds of the iron-master, or the vat-waste of the alkali manufacturer. We forget that the cemetery—though less unsightly than the plots of land to which I have been referring—is, like them, simply a place for depositing refuse-matter,—a refuse, too, which modern sentiment forbids us to think of utilising. Such notions have not always prevailed, or there would be no space on the earth available. But I believe if a burial-ground had been in disuse for five centuries its restoration to agricultural purposes would be regarded by many as "desecration." Few persons reflect what will be the appearance of the neighbourhood of London in another century. By that time, if no fundamental change occurs, burial-room will have been found and provided for more than twelve million human bodies!

Some will advise to meet both the sanitary difficulty and the lack of space by going further afield. They would establish gigantic cemeteries at a distance of 20 or 30 miles from the great city, and convey the dead to their long home by railway. There are not a few grave objections to this proposal, for even greater distances from London the land along the principal lines of railway has become populous and valuable. Sufficiently large vacant spaces could not readily be found without incommoding the rural towns and villages. The expense of funerals, which already proves a sore burden to the wage class and to no small portion of the middle classes, would be notably increased. And in case of infectious diseases, what could be more dangerous and more reprehensible than to take the dead to a busy railway-station? All such schemes as special lines of rail, or even special dead-trains and funeral-stations, would not merely still more enhance the cost of interment, but would involve a shock to the feelings of all concerned. The funeral train, with its cargo of (say) fifty coffins and as many accompanying parties of mourners, steaming out into the country, would have about it nothing of the poetry of grief. Let us picture the unloading scene at the terminus!

From whatever point of view we regard the disposal of the dead, a total change of our existing system is pressed upon us. We cannot continue in our present track. It is surely well to look the only alternative boldly in the face, and consider what objections can be urged against cremation —the disposal of the dead by fire.

The most serious argument that can be offered is, perhaps, that cremation would give a prospect of impunity to poisoners by annihilating the only decisive evidence of their crime. But this difficulty would be overcome by an expedient which is being forced upon public attention on quite other grounds. Our present system of ascertaining and certifying the causes of death is, in the opinion of the coroners of two of the most important provincial cities, far too lax. Were cremation established, in every suspicious case the proper examination would be made at once, and the results would be far more decisive than those obtained from the autopsy and the analysis of an exhumed corpse.

The second argument is one of a sanitary nature. It has been contended that the destruction of so large a mass of organic matter as the human body, by fire, could not be effected without the emission of fumes certainly loathsome and probably dangerous. This objection is entertained only by such as have a totally wrong notion of the arrangements to be employed. True, if we lay a human body upon a heap of coal or wood, and then apply fire, we shall have a scene revolting to our feelings and sickening to the senses. A variety of volatile products, such as Dippel's animal oil, will be given off, and it will be only after a very prolonged roasting that the charred remains will be reduced to their ultimate state—a pinkish white ash. But if the corpse is at once exposed to the heat of a Siemens gas furnace the offensive products of combustion are instantly decomposed into their simple elements; there is no smell and no blackening, but the rapid production of the white ash. It must be confessed that the nitrogen of the body escapes in a free state, and is consequently of no more value from an agricultural point of view. But if we allow animal matter to putrefy, whether above ground or below its surface, a great part of its nitrogen escapes in the same inert condition. Of one thing we may feel absolutely certain—that disease-germs, ptomaines, and any other morbid matter, will have been exposed to temperatures not far below a white-heat, and infallibly destroyed. Under no circumstances, then, can the corpse prove injurious after it has once been introduced into the incinerator.

We may turn now to the economical phase of the question. Will the cost of cremation exceed or equal that of interment? Let us remember that the cost of the present system is threefold. There is a first charge, borne by the entire community of a town or a parish, in purchasing, fencing, laying out a cemetery, and keeping it in order. Then there are the charges which fall upon the family of the deceased. Lastly, comes the loss to the nation, by the withdrawal of a certain quantity of the land from remunerative purposes.

The first and third of these items will be minimised by the introduction of cremation. A couple of incinerationfurnaces, in a small spot of ground decently enclosed, will suffice for the wants of a populous parish. The expenses to the representatives of the dead would be heavy if an incinerator had to be erected specially for a single corpse. But in case of the general use of cremation, as far as I can learn, they would fall below that of an interment. The purchase of the grave, the outlay for the coffin and for the tombstone, would be saved, and against these would come the simple item of fire. The ashes of the deceased might be preserved in an urn, which could be had for a few shillings, and which might find its place in the house of the relatives.

I have now to deal with two objections of a sentimental nature. I am very far from desiring to treat them on that account with contempt, though I must regard them as mainly the outcome of misconception and prejudice.

The many, of all ranks in life, feel disagreeably startled when they hear it proposed to dispose of the dead by fire. They forget that the most refined and cultivated nations of classical antiquity saw nothing revolting in consigning the remains of the departed not to the grave, but to the funeral pile. They forget, equally, the nature of the changes which take place after death. The corpse for some hours, or even days, after life has ceased appears sunk merely in a placid sleep, and may even look more lovely than in life. Fancy paints this state continuing after interment, and the mass of us speak of the dead still "sleeping" in their graves. Nay, popular tradition invests the dead with a kind of dreamy half-consciousness. But could those who muse over the sleeper follow him for even a week after the coffin has been lowered into its cell, they would see that the process is not sleep, but destruction—a destruction as complete as that which ensues during cremation, but more tedious, and passing through loathly intermediate stages which in cremation are absent. Could we but once shake off the prejudices which have overgrown the European mind for more than a thousand years, we should soon be able to idealise the pyre which restores man to the elements, and the funeral urn which receives his ashes. Poetry would find in them themes no less touching than it has found in the tomb and its fancied sleep, or in the churchyard.

The last objection is of a religious, or pseudo-religious, origin. Greece and Rome were, in their proudest and brightest days, what we call "heathen" nations, and they practised cremation. The Jews buried their dead, and, as we have derived from among them our national religion, we have come to speak of "Christian burial," and to brand cremation as "heathenish." Some writers and speakers—not, perhaps, the most enlightened men of the day—have even gone so far as to declare that those whose bodies are thus disposed of forfeit their prospect of a resurrection! A modern scientific traveller, whose works were not long ago reviewed in the "Journal of Science," takes occasion to say that cremation might be well enough for heathen nations, but that we have higher notions of the dignity of the human body. I for one must take leave to say that I see no remarkable dignity in putrefaction. It is, further, well known that the Greeks and Romans were far more attentive to the strength, the beauty, and especially the cleanliness of the human body, than are nineteen out of twenty of the inhabitants of modern Europe.

It is known that cremation is gaining ground in Italy and in Germany. In two recent cases it has been carried out in England without any attempt at official interference. But I am told that the practice is of doubtful legality. It has further been pointed out that the fanatics in whom England is so rich may quite conceivably demand its formal prohibition by statute. Such a demand, if made on behalf of a numerous organisation, would scarcely be resisted by either of the great political parties. It is therefore highly important that the friends of the only rational and practical method of disposal of the dead should be prepared, and take the necessary steps to obtain legislative sanction for cremation at the option of a deceased person or of his friends.

V. THE GERM THEORY AND ITS LATEST CONQUEST.*

IT cannot fail to have struck most thoughtful persons that a combined and systematic atack is being made upon the medical profession, and through it upon medical science itself. Poets, novelists, ethicists, ochlogogues have formed a most incongruous alliance with the Anti-

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* The Germ Theory of Phthisis Verified. By W. THOMSON, F.R.C.S. Melbourne: Sands and McDougall.

Vaccinationists and the Bestiarians. Differing in everything else, they fraternise on the broad principle of hostility to medical research and medical practice. It is asserted that the art of healing has no fixed principles,—that it passes from one extreme to another, swayed by fashion rather than reason, and that any improvements are effected not by the spontaneous action of the faculty, but are forced upon it by the pressure of public opinion.

It may, of course, be asked—What concern is this of ours? We are not, and do not in any way profess to be, an organ of the medical profession; but we see very clearly that if medical science and its practitioners are brought into contempt, all science—and more especially biological science—must suffer. Seeing, therefore, our neighbour's house on fire, we do not consider ourselves bound to remain inactive. On this principle we have defended physiological experimentation for medical purposes, well knowing that in proportion as it is imperilled similar experimentation conducted in the interests of pure biology will be in equal, if not in greater, danger. That for so doing we can be rightly charged with hypocrisy we cannot admit, or even conceive.

Much attention has been for years past drawn to "germs." We find the word used not merely in medical or in scientific circles, but among the general public, and sometimes without any very clear notion of its real meaning. Nor has ridicule been wanting. For centuries we have heard it read in our churches that "A little leaven leaveneth the whole lump." For centuries we have seen fermentations, putrefactions, decompositions, and transformations of various sorts take place, as well in the living body as in dead organic matter, and in substancces which never have lived. But when we are told that these changes, or at least many of them, are induced by "germs," we find it a theme for laughter—asinine rather than Olympian. The British public has never seen a germ, never handled one. A germ is nothing quotable on the Stock Exchange or at Mincing Lane —nothing upon which an impassioned harangue may be delivered in Parliament or at Exeter Hall. And therefore, forsooth, it is a thing to be laughed over—a mere "Hirngespinst"; and those who talk about germs are merely gulling the public, and seeking to hide their own ignorance, Q. E. D.!

Such is substantially the style in which the "germ theory" of certain diseases and of fermentations is talked of by too many of the respectable and intelligent whose sweet voices go to make up public opinion.

At the risk of some hard words we must endeavour to combat this kind of opinion, and to show the world that germs are in no sense to be laughed at, but that an insight into their nature and their actions would conduce greatly to our well-being.

What, then, is a germ? A microscopic being, in some cases of animal, but more commonly of vegetable nature. More strictly speaking, a germ is the egg or seed of such minute creatures. These germs are suspended in the air, scattered over the earth, over vegetation, and over animals, being in fact almost omnipresent. Such germs differ in their nature, and accordingly they produce very different effects. If one of them falls into any suitable liquid,—be it blood, milk, grape juice, &c.,—or upon any solid organic matter, such as the flesh of a dead animal, it becomes developed, and reproduces its like with great rapidity. In so doing it effects most important changes in the matter which it inhabits. Thus suppose we crush a quantity of grapes, and leave their juice exposed to the air, in a short time the juice undergoes that change which is known as alcoholic fermentation. The sugar present in the juice is decomposed, forming carbonic acid, which escapes, and alcohol, which remains in the liquid; this change is effected by a minute plant, a *Saccharomyces*. In its absence neither wine, beer, nor any alcoholic liquid can originate fermentation, as has been experimentally proved. Under certain conditions, further, if wine or beer is exposed to the air, we know that it passes into vinegar. This is the action of a "germ" of another kind. In a precisely similar manner the putrefaction of milk, of flesh, &c., is occasioned by other "germs." If these are absolutely excluded, as in a tin of Australian meat, no putrefaction sets in, and the meat may be preserved for an indefinite time. We may easily learn that it is not the previous boiling which keeps the meat from entering into decomposition, for if we make a small hole into such a tin, so as to admit the air, the meat in a short time becomes offensive. It might be argued that the air itself, independent of any germs which it may convey, occasions fermentation and putrefaction; but this supposition is at once overthrown by the fact that if air is admitted which has been passed, *e.g.*, over red-hot asbestos or pumice-stone in a glass tube, or which has been filtered through cotton-wool, no fermentation or putrefaction arises. On this subject the beautiful experiments of M. Pasteur and of Prof. Tyndall may be regarded as conclusive.

But certain germs are capable, under favourable circumstances, of setting up changes in living animals and plants. They are drawn into the lungs with the breath; they enter the stomach with the food; and in these organs, or in the blood, they set up changes which may be likened to fermentation. That in this manner fevers, cholera, smallpox, &c., are propagated in man, pébrine in silkworms, "charbon" in cattle, may be considered proved beyond all doubt.

We know it has been asked why, if such be the case, are not all persons attacked by fevers, &c.? The answer is, firstly, that the "germs" of those diseases are not equally present either in time or space. During the epidemics of cholera or plague a very large part of the persons in the districts affected, sometimes even a majority, are attacked. Again, climatal and seasonal conditions vary: the germs of yellow fever do not seem capable of reproducing themselves in the British Islands, whilst those of smallpox, diphtheria,* and scarlet fever find no difficulty in crossing the Arctic circle. Lastly must be considered the personal element. Some men have evidently a greater power of resistance than have others. If exposed to infection they take the disease slightly, or not at all. The case is precisely similar with ordinary fermentation. The brewer seeks to have his worts always in the same condition, and to effect the fermentation in one unvarying manner; yet sometimes in spite of all his tact and experience, aided by all the resources of modern science, a brewing fails. Need we then wonder if, in the vastly more complex field within which disease germs act, the results should vary?

A certain writer whose works we lately noticed, and who is disposed to be very severe on our medical men, and upon the "germ-theory" as the fashion of the day, thinks that rinderpest and other cattle diseases would disappear if cattle were kept under better sanitary conditions. Unfortunately it has sometimes happened that cows were attacked on model farms, where every care was taken for ventilation, drainage, cleanliness, and pure water, whilst the disease passed harmlessly over others which were housed and kept in the filthiest and most slovenly manner.

But we must hurry on to our more immediate subject. Phthisis—or, as it is commonly called, consumption—is of all diseases the commonest and the most hopeless. That it carries off about one-third of our adult population, or rather of those who have reached the age of puberty, is admitted.

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* During the past month diphtheria has been very severe in the Loffoden Islands.

That the number of complete undoubted recoveries is exceedingly small no one will deny; so small, indeed, as to permit a doubt whether in such cases the disease had been rightly diagnosed.

Now till lately the cause of this havoc, though much discussed, was unknown. Popular tradition in some districts pronounced consumption "catching," but the notion was generally treated as an old wives' fable. Curiously this view seems to have been most generally entertained on the coasts of the Mediterranean, and especially in Southern Italy.

A favourite delusion has been to connect consumption with climate. It was supposed to be endemic in England, and any warmer climate free from extreme temperatures was recommended. Hence consumptive patients, in the beginning of their sufferings, were sent off to the Undercliff of the Isle of Wight, to places on the south coast of Devon, to Cannes, Nice, Algiers, Naples, Madeira, Australia, or the Cape. In the same way American consumptives repaired to Florida or the West Indies. But the fatal truth by degrees came out that consumption prevails alike in hot and cold regions, on the sea-level or on lofty table-lands, in dry or in moist air. In Australia phthisis is substantially as fatal as in England, and carries off more of the black aborigines than does any other malady. Consumption, in short, is not derived from "taking cold," though, where existing, it may be aggravated by a cold.

Nor can it be said that in-door sedentary occupations and over-crowding are *in themselves* the cause of the mischief. Neither yet can it be deficient food or insufficient clothing.

That in the absence of any knowledge as to the cause of the disease no rational system of treatment could be devised needs no proof. So matters stood; consumption being most emphatically the *opprobrium medicinæ.*

The author of the little work before us seems to have been the first who threw light upon the question. In a pamphlet published in July, 1876, entitled "The Histo-Chemistry and Pathology of Tubercle," he asserts the parasitic origin of phthisis. He puts the question, "How would specific Micrococci operate as the proximate cause of the equally specific morbid process of general tuberculosis?" In answer to his question he wrote—"I therefore venture to think they will probably be found to operate as the exciting, efficient, or, better, proximate cause—the *materies morbi* of tubercle." He minutely explains the mode of action of the parasitic germ in producing that aggregation of cells forming a tubercle, which is first grey and then yellow. He says:—

"In this mass of epithelial *débris* the minute bodies of the microzymes are set embalmed, or buried, as it were, in the ruins they have produced." Mr. Thomson justly calls attention to the analogy between this sentence and the following passage from a later work of Dr. Koch, the head of the German sanitary department. This eminent authority writes:—"It is in the highest degree impressive to observe in the centre of the tubercle-cell the minute organism which had created it."

Mr. Thomson also showed in his first work that the occasional aggravations of the fever, cough, and other symptoms of consumption, are due to the development of a fresh crop or generation of the parasitic germs.

These ideas of the authors have been since abundantly verified by observation and—if in these good days we may venture to speak of such a thing—by direct experiment upon animals. Inoculation with tubercular matter has produced tubercular disease. The attention of the faculty and of the public being thus turned in the right direction, evidence of the infectious nature of consumption became multiplied. The author gives some very striking cases. Here we find, for instance, that a strong robust man marries a "delicate" (we hate the word) wife, who soon died of phthisis. The man soon fell off in health, and is now in the second stage of acute consumption. An active healthy young man leaves Melbourne for a holiday trip to the old country. On his return voyage he occupies a narrow cabin with a phthisical invalid in active disease. Not long after returning home he too was attacked. But for further cases we must refer to the author's work.

It is a trite saying that a true theory may soon be known by the ease with which it lends itself to facts. This is eminently the case with Mr. Thomson's views. Consumption is always said to be most fatal among persons who live, work, or sleep in narrow confined rooms. If it is infectious this is precisely what we should expect. Such persons will be far more likely to inhale the deadly matter than if their occupation were in the open air.

Again, phthisis is hereditary, and runs in families. True, and what is more probable than that the child should receive the infection from its mother, and the sister from the brother?

Are we justified in regarding the discovery of Mr. Thomson as a great triumph, sufficient in itself to demand a retractation of the rash censures which have been uttered against medical science? Emphatically, yes! Knowing that consumption is transmissible from one person to another, we shall at least know how to prevent or greatly to limit its propagagation. Henceforth intermarriage with a phthisical person will be not only a physical sin, endangering the health of possible children, but a case of constructive suicide. Can none of our ethical writers, so concerned about virtue and happiness, see their way to enforcing this truth? Again, it will become not merely policy, but duty, on the part of those who live in the same house with a consumptive patient, to take jealous care not to contract, and ultimately to propagate, the disease. No one should share the bed, or even the bed-room, of the patient; the bed- and body-linen should not be washed along with those of other persons, and should, after washing, be stoved with sulphur, or be taken through a solution of sodium bisulphite, slightly acidulated with hydrochloric acid. The matter expectorated, which is the chief source of danger, should be received in spittoons charged with some powerful disinfectant,—say carbolic sulphite; the contents should be emptied not into the dust-bin, but into the fire. As far as possible people should, when travelling in public conveyances, avoid sitting next to or opposite to any person who has a cough. Tram-cars and railway carriages are bad enough, but the greatest danger is in the inside of an omnibus, where the passengers on opposite sides are brought so unpleasantly near to each other.

Neither Mr. Thomson nor any of the distinguished physicians who have since verified and extended his discovery have been, as yet, able to lay down a definite process for the treatment of consumption. But the profession know now, at least, in what direction to look. The remedy must be a "germicide,"—a destroyer of the lower and more minute forms of life. It is fortunate, we may here remark, that the Microzymes or Bacilli, which occasion both fevers and phthisis, are pronounced by high authorities to be of vegetable nature. Were they animals we should perhaps find "*Zoo*-folly" protesting on their behalf. Some sage would make the notable discovery that they "have equal rights" with ourelves, which "are in no case to be hastily and unfairly set aside." Perhaps the day may come when a license from the Secretary of State will be needed before a physician dare administer an anthelmintic medicine to his patient. But the germs of phthisis being, as we have said, plants, have no "rights," and may be dealt with at pleasure.

It is a sad but curious fact that Mr. Thomson has earned small thanks in Melbourne by his discovery. We do not, indeed, learn that the Australians treat phthisis as a vested interest to be reverently conserved on ethical grounds, as some of the "unco guid" do at home with another disease which is secretly undermining the vigour of the race; but they regarded it as a libel to be told that the Australian climate was no antidote for or safeguard against consumption, and that natives of Australia, black or white, were as liable to this scourge as if they had been born in Britain. For seeking to arouse his neighbours from this delusion the author has been proclaimed a fanatic and a firebrand. A premier of Victoria actually asked him—"What are our young people to die from, since they may not die from typhoid fever or phthisis?" Surely he was a typical specimen of the men whom we "Anglo-Saxons" at home or in the Colonies set to rule over us!

VI. THE HEADS OF GREAT MEN, AND THEIR OCCURRENCE.

By D. Yewdall Cliff.

DR. GILBERT, Physician to Queen Elizabeth, so famous for his researches in magnetism, was, it is said, the first to suggest that men of great intellectual powers have large and massive heads. This conclusion is as commonly accepted as it is agreeable to ourselves in theory; but if before deciding we take a review, by means of the busts, pictures,* photographs, &c., of the world's most famous celebrities, the opinion most certainly is not universally borne out by facts. I have noted in earlier paintings that men are distinguished by this trait, showing that the painters had, perhaps, also the same notion. In Mr. Wallace's "Australasia" there are as fine heads, of savages, as ever civilisation has produced, apparently in the pure native. The remark of a wise Englishman, "If perseverance is not genius, it is something very like it," may therefore not unlikely be true.

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* *See* Art Journals; Cassell's, Ward and Lock's, Macmillan's, &c., publications; The Graphic, Illustrated London News, &c.

I have not had the opportunity of going deeply into the matter, but I believe that often it is the father who has the massive head and large brain, a fact which seems in some way to cause the brain of his offspring to be of that nature which produces a genius; but I do not like to venture far on this ground. Compare, for instance, the two Skobeleffs, the Russian generals; if the "Graphic" sketch be correct the father has a far superior head to his more famous and talented son, lately deceased. Compare Bismarck and his father (not very fine), the first two Peels, &c.

There is also another curious item, which I do not ever remember seeing noticed,—all the great men of ancient and modern times have noses arched outwardly, the bridge not being depressed. Perhaps Socrates is an exception. Cyrus (of Persia) is said to have had a very peculiar nose, and Napoleon is reported to have declined to make a general of a man faulty in this respect.

A receding forehead is generally condemned; nevertheless this feature is found in Alexander the Great, and to a small extent in Cæsar; also in the Sphinx (1400 B.C.), which must have embodied the Egyptian ideal of perfection; in Savonarola, of Italy, and in our own James Watt.

Other great men have positively small heads; that of Lord Byron was "remarkably small," also those of Cosmo di Medici and Lord Bacon.

Many men of genius of ancient times have only what may be called an "ordinary" or every day forehead; for instance, Herodotus, Alcibiades, Euripides, Plato, Aristotle, Sophocles, Escliades, Epicurus, Severus, Lucius Verus, &c. And among the moderns, Swift, Goldsmith, Otway, Bunyan, Calvin, Erasmus, Luther, Linnæus, Rembrandt, Ariosto, Johnson, Molière, Chaucer, Wedgwood, Caxton, Moore, &c. Many are of a medium size, as Rameses II., Homer (reputed bust), Æschylus, Demosthenes, Augustus, Leonardi da Vinci, Otto III., Cervantes, Loyola, Richelieu and Mazarine (fine), Addison, Chatham (Pitt), Crompton (male), Cartwright (loom), Moritz Retzch, Watteau, &c.

Those that are remarkably fine and massive do not constitute the majority: we may mention Eschines, Cicero, Hippocrates, C. Scipio, Melancthon, P. Corneilli, Rabelais, Roger Ascham, Defoe, Rennie, "the" Felton, Fulton, Julius II. (Pope), Galileo, Crabbe, Shakspeare, Hannibal, Boccaccio, Voltaire, Shelley, Wordsworth, &c.

Then, again, some are even low-browed, as Robert Burton ("melancholy"), W. Kalf (painter), Diogenes, Sir Thomas Brown (forehead "remarkably low and depressed")—

"Macmillan" (s. xxvii.,); monarchs in plenty — Nero, Caracalla, Trajan, Louis XIII., &c.; and Albert Durer, Raphael, Luther, Arkwright (spinning-frame), Alexander, Miltiades, &c. This is, of course, relying on what portraits we have,—a necessarily imperfect source, but sufficient to give weight to my assertion.

This study of the head is extremely interesting, and it is significant that the literary patricians of Rome used to place the bust of an author amongst his own works, the group being incomplete unless the man was seen.

But to take up another subject. The literary and historical student cannot fail to notice how rarely the same name re-occurs in history, &c., particularly where a family connection can be traced; and when it does happen it is either very remote or quite immediate, as father and son, &c. It would seem as if a race gradually came to a climax in some genius, greater or smaller, and dwindled off again, either dying out or beginning again to improve after a relapse. It is noticed amongst some carnation growers that many of these plants seem to have a "constitution" which carries a new seedling through a certain number of years, and then it dies out, no matter how largely it has been split up by layering, &c. But be this so or not, it is, I think, evident that this is a fact with the human species, individually and racially.

Are there two Aquinases, two Dantes, Ariostos, Tassos, Machiavellis, Racines, Cervantes, two Chaucers, Marlows, Spensers, Shakespeares, Miltons, Blakes, Congreves, Newtons, Pepys (!), Shelleys, Lockes, Gibbons, &c.? No. Each race originated in some happy marriage, &c., culminated,—and was not.

But there are exceptions: there were two Cromwells, equally great geniuses in their day; but then other families must have had their influence through marriage.

And there are a few others: some may appeal to a line of kings, our own for instance. We cannot consider everything for want of room and interest. The Saxon line was the longest that ever reigned in England, beginning with Cedric (519—1042), giving us sixteen kings in the direct male line from Egbert to Edward the Confessor. The Plantagenets rank next (1154—1399), which line gave in direct male descent twelve kings.

Let us consider the individual kings who may claim the rank of genius, recollecting that such a race has the very best possible earthly chance. From the conquering Cedric to Egbert is three hundred years. Ina—who is famous for his code of laws—is the only intervening king worthy of notice. Egbert cannot be classed high; accident, not conquest, made him "king of the English." Alfred is the genius of his race; besides him ranks only Athelstan, the conqueror of Scotland and the "Emperor of Britain." Of the House of Anjou, Henry II., Edward I. and III., and Henry V. are worthy of mention: of these Henry V., and perhaps Edward I., may claim the rank of genius. The House of Tudor was probably best sustained (1484—1603); Elizabeth was the genius. William the Norman might claim to be the genius of his line, but we can hardly rank a Stuart (in England) amongst this class. Finally comes the line of Brunswick, which has yet its genius to produce: it has ample opportunity. We have no king as yet who will stand in the first rank—with Napoleon, Charlemagne, Cæsar, &c.

But to return: it often happens that near relations have eminent abilities, but not of the first rank: for instance, the Zuingles of Switzerland, the two Vanes, Hamilcar, Hannibal, the Medici; Sir W. Davenant claimed to be Shakespeare's son; the Colmans (father and son), Coleridges (father and children), Fletchers (P. and G., brothers), Corneilles (brothers), Fieldings (brother and sister), Sheridans (mother and son), &c.

We often find the same name recur, but are unable to trace a family connection, which probably never existed. Such persons, it must be noted, are as a rule very wide apart. Thus there are the two Butlers,—authors respectively of the "Analogy" and of "Hudibras,"—the two yet more famous Bacons, and a host of less prominent instances, Moores and Mores, Sidneys, Smiths, Taylors, Tindals, Whites, Harringtons, and Greens.

If we take a wider survey of man we find history not merely repeating itself, but presenting its parallelisms. Let us bear in mind Mr. Pfoundes's researches on the development of old Japan, and compare it with the history of European countries with which that island empire had in those days no connection.

According to Mr. Pfoundes the feudal system was introduced, perfected, and completed there at the same time as in Europe. Hallam fixes its culminating point for Europe in the eleventh century. It was the same in Japan. Japan destroyed her convents and disbanded her monks within about a century after the time of Henry VIII.

M. E. Renan, in his "Life of Jesus," makes the following interesting observation, which bears exactly on this point:—"The history of the human mind is full of strange coincidences, which cause very remote portions of the human species, without any communication with each other, to arrive at the same time at identical ideas and imaginations. In the 13th century the Latins, Greeks, Syrians, Jews, and the Mussulmans adopted scholasticism, and very nearly the same scholasticisms from York to Samarcand; in the 14th century everyone in Italy, Persia, and India yielded to the taste for mystical allegory; in the 16th art was developed in a very similar manner, in Italy, at Mt. Athos, and at the Court of the Great Moguls, without St. Thomas, Barhebræus, the Rabbis of Narbonne, or the Motécallémin of Bagdad having known each other, without Dante and Petrarch having seen any Sofi, without any pupil of the school of Perouse or of Florence having been at Delhi."

It is interesting to notice the average foreheads of the Greek sculptures as seen in the friezes from the Parthenon, in the British Museum. They are, if anything, lower than the average seen in modern foreheads. About this fact there can be no mistake, which is significant if we suppose that the Greek artist would reproduce the average types prevailing among his countrymen. The gods themselves are represented with ordinary, if not low, brows. This might be intelligible in Bacchus and Herakles, but not in Apollo and Zeus. Many of the groups also display what we should call short, squat figures, though the gods are figured with finely proportioned limbs. Probably many reflections which might here arise escape us from their very nearness.

VII. DETECTION BY ELECTRICITY OF THE ANNUAL CULMINATIONS OF THE SOLAR INFLUENCE ON ORGANISMS.*

By Nils Kolkin.

It came to my notice, several years ago, that if one end of a hair or thread were tied to a watch-key, or some similar object, and a person, seated comfortably before a table, with his elbow resting on the same, took hold of the other end, so as to raise the key from the table and keep it suspended, it was impossible to keep it still, in spite of all precautions. Oscillations would begin which, if the hands were warm, would attain great violence. If the key were permitted to strike against anything except glass, silk, dry rusty iron, or other bad conductors of electricity, the oscillations would be interrupted by short pauses occurring at regular intervals; and the strokes between these pauses would correspond with the age of the hair, or, more correctly, their number would show how many years old the person was when he lost it. I understood that these oscillations were caused by electricity; that the key was positively or negatively charged and repelled by the arm and hand, which were similarly charged.

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* Read at the Montreal Meeting of the American Association for the Advancement of Science.

I have since investigated this phenomenon, as much as my time has allowed, and I shall here carefully give the results of my experiments. I have also substituted electricity from other sources than that used in those primitive experiments, and when I have not met the same success it is due to the fact that I am not a practical electrician.

There is no known principle that accounts for the pauses in the oscillations. But the explanation seems to be that—When any organic substance is continually charged by positive or negative electricity, and discharged in rapid succession, under certain circumstances, the substance itself, and things in contact with it, will, after a certain number of discharges, for a moment become non-conductors; and the number of those discharges will correspond to the age of the vegetable or animal from which the substance is derived. I say "under certain circumstances," for I do not know whether repulsion and attraction is necessary or not. My experiments have always been with a suspended key, except with a metallic spring, placed horizontally, which is virtually the same thing. The resistance to electricity during the pause is, indeed, very slight; it does not take a very powerful charge to overcome it. The weaker the supply of electricity the better it is. Shortening the fibre by which the key is suspended will give the best results. It will make the oscillations more rapid, and they ought to be rapid enough to make it necessary to count them by twos, for the pause will thus be better noticed.

All organic substances possess this age-telling property, except absolute non-conductors, as silk. If substances of different ages are used together, the age of the oldest only is shown. This fact makes it possible to find the age of substances of all forms, even with a suspended key. A fibre of an annual plant may be used, and any dry substance tied in it: in case of liquids, the fibre may be saturated with them. Liquids are good conductors, and must be guarded against. The smallest particle of juice, or sweat, on anything, when of higher age, will show its presence.

The age of a substance here must not be taken to mean the time it has existed as such, but that age which the vegetable or animal that may be its source had when its connection with that source was severed. A leaf may be two months old, but it shows the age of the tree; a drop of milk, that of the cow. I have permitted myself to call this "organic age;" but as we have nothing to do with any other kind here the word "age" must always be taken in this sense. Any part of an organism—any seed, fruit, secretion, or any part of product whatever—has the same organic age as its source. The age of vegetables counts from the time they sprang from seed. Those propagated from roots or cuttings have the age as the original. A potato showed between 800 and 900 years. The age of animals corresponds with what is commonly termed so; but new-born young have the same organic age as the mother.

This age-telling property of organisms does not seem to be destroyed by time. To what extent chemical change does it I cannot say. Considerably decayed wood retains it. Some kerosene, which caused the discovery of the age-telling property of liquids, showed constantly eight years: but this might have been due to some foreign substance.

It is, of course, plain to all that the interruption of the oscillations has nothing to do with our civil year as it is divided off in the almanac, but with a natural year. A natural year in our zone consists of an increase, a culmination, and a decrease of the solar influence. It is the number of those annual culminations to which an organism has been exposed during life that is shown. In case of annual plants, grown during the increase or decrease, they will show a year though they have not been exposed to the maximum influence of the sun. So with animals less than a year old. The oscillations generally cease very abruptly, but when a considerable fraction of a year remains uncounted there is often a gradual subsidence into a pause. How it is with organisms under the equator, where the sun passes twice a year, I do not know. But a knowledge of it would throw some light on this question.

That the sun has great influence on plants all know; but that it should have so great an influence on animals that each annual increase, culmination, and decrease of that influence should be registered in their organisms will seem to many a great heresy. The sun, however, has more power than is generally supposed. Many persons will know that they do not feel the same under its decrease and increase. They do not seem to be the same persons in the autumn and in the spring, everything else being equal. The influence of the sun pervades all Nature, and reaches life, both animal and vegetable, in recesses completely hidden from its rays.

VIII. NOTE ON PINK OR ALBINO CARP.

By A. Anthony Nesbit, F.C.S.

IN order to ascertain whether the change in the colour of carp effected by light, mentioned in the "Journal of Science" for June, was due to change of shade in an existing pigment, or whether light acting on the epidermis manufactured an entirely new pigment, two albino or pink carp were taken, and one placed in a plain glass globe, the other in one of the same size coloured dark blue, and both placed in the same degree of light. After three weeks' exposure the fish were placed in separate clear glass globes, and compared and pronounced by three independent observers to be practically unaltered.

This fact appears to indicate that light merely modifies an existing pigment which is absent in the pink or albino fish, and which it is powerless to manufacture.

IX. THE ACTION OF POISONS ON THE PETALS OF FLOWERS.

By A. Anthony Nesbit, F.C.S.

I. *The Alkaloids.*

IT having come under my notice that a flower placed in water into which some tobacco had accidentally fallen faded with surprising rapidity, I resolved to make some experiments on the action of various substances on the life of flowers, and for this purpose selected some of the best-known alkaloids, *viz.*, strychnine, solanine, digitaline, quinidine, atropine, quinine, cinchonine, picrotoxine, aconitine, brucine, and morphine, using ¼ per cent and 1 per cent solutions. The alkaloid of tobacco being very difficult to obtain pure, owing to its rapid oxidation, 5 per cent and 20 per cent solutions of tobacco (bird's eye) were used in its stead. The flower chosen for experiment was the narcissus, and the results showed that there was here a wide field for long and patient investigation.

Of all the twelve solutions tobacco proved, in a very marked manner, to be most destructive to the life of the flower of the narcissus; the remaining eleven poisons, though but slowly injurious, nevertheless in some instances showed marked difference of effect, or, it may be said, symptom. Thus strychnine, next in poisonous power to tobacco, drew the petals upwards, and made them dry and brittle, symptoms also exhibited by solanine poisoning, while quinidine and several other alkaloids rendered the petals limp and rotten. Morphine, one of the least poisonous (to the narcissus) of the alkaloids experimented with, without destroying the flower, curiously enough imparted to the petals a flaccidity resembling that of the petals of the poppy.

(To be continued.)

ANALYSES OF BOOKS.

Chapters on Evolution. By ANDREW WILSON, M.D., F.R.S.E., F.L.S., &c. London: Chatto and Windus.

THE object of this work, as declared by the author himself, is "to present, in a popular and readily understood form, the chief evidences of the evolution of living beings." To some extent, therefore, it covers the same ground as a work by Mr. Romanes which we had the pleasure of noticing in our October issue. Dr. Wilson, however, takes a wider scope, and at the same time enters more into the details of the evidences for the New Natural History, and his work is necessarily of greater extent. In the opening chapter he calls attention to a distinction commonly overlooked by gainsayers and outsiders. "Darwinism," he shows, is not synonymous with Evolutionism, but is "to be regarded merely as one, but also as probably the strongest, phase of those speculative endeavours to show the 'how' of living nature." In this same chapter a consideration is put forward which, though taken from Mr. Herbert Spencer, is not as widely known as it deserves to be. Early ideas, whether belonging to the childhood of the individual or to that of the race, are not usually true ideas. We have been compelled to reject the astronomy, the physics, and the chemistry of the ancients. Why then should it be different with their biology, and especially with its leading tenet, the doctrine of special creation, or rather of special origination? * "If the interpretations of Nature given by aboriginal men were erroneous in other directions, they were most likely erroneous in this direction. It would be strange if, whilst these aboriginal men failed to reach the truth in so many cases where it is comparatively conspicuous, they yet reached the truth in a case where it is comparatively hidden." What candid thinker can help feeling the great weight of this contention?

After summarising the teachings of Darwin in a series of eight propositions, Dr. Wilson shows that the term "biology," first introduced by Lamarck, is a more precise, and therefore a preferable, name for the discipline formerly known as "Natural History." We must here, however, join George Henry Lewes in his regret that " certain quacks, with customary ignorance, have vulgarised and distorted the term Biology, and applied it, in contempt of Greek and Science, to their " Mesmeric operations."

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* We must remember that the men who uphold the fixity of species are by no means necessarily Theists. France can show abundant evidence to the contrary, especially the Positivists.

Dr. Wilson then proceeds to explain the divisions of this vast science, namely, morphology, the science of form,—comprising anatomy, development (commonly called embryology), and taxonomy or classification; secondly, physiology, the science of function,—the distribution of species in time and space, or organic geography and palæontology; and lastly, what Dr. Wilson calls the ætiology of animals and plants,—that is, the inquiry How has each species come to be what it is?

Inquirers of this last kind were a few years back " relegated to the domain of the unscientific, if not to that of the impious as well." Even now they are looked upon with very different feelings. The other day Prof. Stokes could say, at the Church Congress at Derby, " I prefer resting in the statement of a special creation without prying into its method "—an attitude which, if consistently adopted, would render all Science impossible. A contrasting and a far worthier position is taken by Dr. Martineau, who, as here quoted, says, " What, indeed, have we found by moving out along all radii into the Infinite?—that the whole is woven together in one sublime tissue of intellectual relations, geometric and physical, the realised original of which all our science is but the partial copy. That science is the crowning product and supreme expression of human reason. . . . Unless, therefore, it takes more mental faculty to construe a universe than to cause it, to read the Book of Nature than to write it, we must more than ever look upon its sublime face as the living appeal of thought to thought."

In the third chapter Dr. Wilson expounds further the constitution of the animal and plant kingdoms as bearing on the theory of descent, and gives a sketch of the primary classification of both the organic kingdoms.

Chapter IV. is devoted to protoplasm, the physical basis of life. Here the author states that " the latter substance (protoplasm) is resolvable by chemical analysis into the elements carbon, hydrogen, oxygen, and nitrogen, along with mere traces of sulphur and phosphorus." We read, further, that " Chemically, protoplasm stands as the type of a class of compounds, to which Mulder gave the name of proteine substances. . . . Of such substances common albumen, seen in white of egg, is a familiar example; and white of egg, indeed, hardly differs, save in minute chemical particulars, from proloplasm itself." Here it must be remarked that opinions differ. J. Reinke (" Botan. Zeitung," 1880, No. 48), having examined protoplasm obtained from the fruits of *Ethalium septicum*, detects in it, in addition to the elements above mentioned, calcium, magnesium, sodium, potassium, and iron. He maintains, further, that protoplasm contains scarcely 30 per cent of proteine-like matter, and that " it can no longer be spoken of as a coagulum of white of egg." It may also be contended that the chemical identity of the protoplasm of all animals and of all plants is not proven, since it has been actually examined in very few cases only. Indeed from multitudes of forms it would be impracticable to obtain protoplasm in quantity sufficient for analysis. It must, however, be recognised that an established difference in the chemical constitution of the protoplasm obtained from different species would be a serious difficulty in the way of the Evolutionist interpretation of Nature. If all beings are descended from one common origin, it seems probable that their matter and their ultimate texture will show marks of such relation not less distinct than do their outward forms. We doubt whether, *e.g.*, the blood-elements and the spermatozoids have been sufficiently studied from this point of view in mutually allied forms.

Concerning the origin and nature of life Dr. Wilson's views may perhaps be summarised in the following extracts :—

"It is by means of protoplasm that the cells of the liver secrete bile ; it is through the properties of protoplasm producing new cells that a scratch heals or other breach of bodily continuity is repaired ; and it is by means of a peculiar functional development of this same substance that we are able to lay the flattering unction to our souls that we are the possessors of mind, intelligence, and will."

"Of the differences in the inherent nature of protoplasm under different conditions we are as yet in complete ignorance."

Again : "Nowhere do we find life dissociated from protoplasm, and this fact alone argues in favour of the view that the 'vital force' of the scientist or the 'vital spark' of the poet is in each case merely the convenient and summary expression of that high form of energy which corresponds to no one force in Nature, but to all combined." It might perhaps be permissible to ask for a more precise statement of the last clause.

The writer goes on to quote the following significant passage from Prof. Huxley :—A mass of living protoplasm is simply a molecular machine of great complexity, the total results of the working of which, or its vital phenomena, depend, on the one hand, upon its construction, and on the other upon the energy supplied to it ; and to speak of 'vitality' as anything but the name of a series of operations is as if one should talk of the 'horologity' of a clock."

After these preliminary considerations Dr. Wilson proceeds to the various evidences in support of Evolution, taking in succession those from rudimentary organs, from the tails, limbs, and lungs of animals, from the doctrine of likenesses (homology), from the missing links, from development, from the life-history of insects, from the constitution of so-called colonial or compound organisms, from the fertilisation of flowers, from degeneration, and from palæontology. All these various classes of evidence are handled with consummate ability and with a wealth of illustration which speaks highly both for the author's wide and profound learning and for the skill with which he can bring his knowledge to bear upon the point at issue. Of especial merit is the chapter on " Missing Links." Dr. Wilson is particularly plain and emphatic in correcting an error into which even highly educated men—not to speak of gainsayers prone to the *suppressio veri*—still at times fall. He writes :—" The knowledge of what Evolution really teaches and reasonably demands constitutes the first condition for ascertaining what ' missing links ' are required. To bridge over the gulf between the gorilla or any other anthropoid ape and the human type may be the life-long worry of unscientific minds contorting the demands of Evolution. It is certainly no business or labour of Mr. Darwin and his followers, or of any other school of Evolutionists. Mr. Darwin, writing in his ' Descent of Man,' and after a review of man's theoretical origin, is careful to add—' But we must not fall into the error of supposing that the early progenitor of the whole Simian stock (including man) was identical with, or even closely resembled, any existing ape or monkey.' We must, in truth, look backwards along the files of time to the point whence, from a common origin, the human and ape branches diverged each towards its own peculiar line of growth and development on the great tree of life." In another passage, protesting against the same error, he says—" Mr. Darwin's theory does not demand that the gorilla or any of his compeers should be directly connected with man. The gorilla lives, so to speak, at the top of his own branch in the great tree of life, whilst man exists at the top of another higher and entirely different bough."

Is it too much to hope that, after this plain explanation, people will no longer affect to be shocked at their supposed descent from the Anthropoids ?

But Dr. Wilson shows that the absence of " missing links " in various parts of the animal kingdom is to be expected. We know that there are at present a number of very well-marked forms—commonly called breeds or races—of the domestic pigeon. Yet all these varieties are descended from one common stock,—the rock pigeon (*Columba livia*). But where are the intermediate forms connecting the pouter, the fantail, the carrier, and the tumbler with the original stock ? They are not to be found, and there is no record of their existence. If, then, the absence of intermediate forms between (say) birds and reptiles is held to prove that they have not sprung from one common stock, but have had independent origins, it must follow, on the same principle, that the pouter and the fantail did not spring from the rock pigeon, but are primordially distinct, which is absurd. That, moreover, such intermediate links have been found between the birds and the reptiles, as well as between many other groups not respectively isolated, further strengthens the author's case.

Another specially important and interesting chapter is that which treats of the evidence from the constitution of compound —or, as they are technically called, "colonial"—animals. Here we encounter certain most interesting philosophical questions, to which we may return on a future occasion. The author states— "In the reproduction of the bee race certain of the eggs are impregnated or fertilised, whilst others are allowed to develop without the performance of this process, rightly deemed of essential nature to the propagation of both animals and plants. Now the eggs of a queen bee which she lays in an *unfertilised* condition invariably develop into *drones* or male bees, whilst the fertilised eggs become females or neuters."

We are bound here to point out that the Abbé Giotti Ulivi, after a prolonged course of observations on hive-bees, comes to a different conclusion. He finds that every egg that hatches into a male or female has been previously fertilised, and that parthenogenesis among bees is not proven.

The chapter on the evidences from degeneration will prove instructive reading for those—and they are many—who conceive that Evolution in the species or the individual necessarily involves an advance towards perfection, or, in other words, that change is always for the better.*

We are now, however, warned that we have already exceeded our limits. We will therefore merely add that there are two classes to whom the study of Dr. Wilson's book may be especially recommended,—to all candid doubters and gainsayers, and, on the other hand, to disciples in Evolution, that they may learn how to render a good reason for the views which they have embraced.

Metals; their Properties and Treatment. By CHARLES LOUDON BLOXAM. New Edition; partially re-written and augmented by ALFRED K. HUNTINGTON. London: Longmans and Co.

WE have here an improved edition of a work which has been favourably known to teachers and students of metallurgy. The present editor has added a somewhat extensive chapter on fuel, in which he takes into consideration wood, charcoal, peat, lignite and coal of all classes, coke, and gaseous fuel. The applications of petroleum in smelting metals are not discussed. On the utilisation of the bye-products of coke-burning, such as tar and ammonia, the author does not seem very sanguine. He considers that hitherto little or no saving was effected by the preservation of these products. Should the value of the tar, &c., rise, whether from an increased demand or from a falling off in the activity of gas-works, the case may become different.

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* The same error is committed in Sociology.

As regards another desideratum, the removal of sulphur from coke, the author considers that no satisfactory process has as yet been devised. He calls attentron to the not unfrequent presence of phosphorus in the ash of coal as a source from which this unwelcome impurity may be introduced into iron.

Under the title " Refractory Materials " a short but useful section is given, including an account of the now celebrated " basic lining of Messrs. Gilchrist and Thomas.

The author then proceeds to a consideration of the metals, their purification and their uses, *as such*, it being understood that their applications as oxides, chlorides, salts, &c., are not included in the plan of the work.

In the section on iron we find a notice of the most recent improvements, such as the Siemens-Martin process, that of Pernot, and the " basic process " of Thomas and Gilchrist. The author considers that steel will ultimately be manufactured as cheaply as iron, and that wrought iron will consequently, among civilised nations, become a thing of the past.

Under " Copper " we find the note that " Our market is now ruled by the price of Chili and Australian copper, and not by the standard fixed by the Swansea smelters, as formerly." If this means that the great copper " ring "—perhaps at one time the most powerful of similar combinations—has come to an end, all consumers of copper may be devoutly thankful.

We do not find any reference to the Hollway process for the treatment of sulphides. Phosphor-bronze is briefly referred to, but not under its usual commercial name.

The author has included even some of the less common metals in his survey, such as palladium, cadmium, magnesium, and sodium. The process for the metallurgical treatment of iridium, said to have been recently invented in America, has escaped his attention.

The work appears, as a whole, to be an excellent summary of our present knowledge in metallurgy, and as such will be duly appreciated by the numerous classes of persons concerned.

The Doomed Comet and the World's End. By J. A. WESTWOOD OLIVER. London: Wyman and Sons.

THE author of this work sets out with the very laudable intention of preventing a panic being conjured up by occasion of the comet now or recently visible. He writes :—

"The present occasion offers an unusually good opportunity to the gentlemen who would fain see us all in a better world. Hitherto the fatal comet has always been going to strike our earth. This time it is to poke up the solar fires, and so cause us to be cremated where we stand. There is thus the great advantage of novelty. Then they can quote the statements of one of our ablest astronomers to bear them out. The fact that he has contradicted what he has said goes for nothing. Altogether they have the chance of making a very good case of it, and if they do not—why, they are not at all up to their business."

We may here remark that as far as England is concerned, the solar fires would bear a very considerable "poking up" before we should have cause to complain. For ten years we have had nothing worth calling a summer, and the three winters of 1878-79, 79-80, and 80-81, have been more Russian than British in their character.

To return: Mr. Oliver first examines the probability of the present comet, or, indeed, of any comet, falling into the sun. He informs us that the comet of 1843, which Professor Boss considers identical with the one now under consideration, passed within 80,000 miles of the sun's surface,—a perilous proximity. As the present comet has returned much earlier than was anticipated, it is probable that the great resistance which it must have encountered in traversing the solar "corona" must have notably shortened its orbit. If Professor Boss is right in his belief in the identity of the comets of 1840, 1880, and 1882, we may be, thinks our author, on the eve of witnessing a "curious consummation."

Next comes the question of the effect of a comet's downfall upon the sun. Sir Isaac Newton was of opinion that the comet of 1680 would fall into the sun, after some five or six revolutions. "Whenever that time shall arrive," he declared, "the heat of the sun will be raised by it to such a point that our globe will be burned, and all the animals upon it will perish." The author here remarks that Newton's opinion was based upon erroneous notions regarding the nature of the comets. He held them to be "solid, compact, fixed, and durable, like the bodies of the planets." He contends that there is no reason to believe that "the heat of the sun will be greatly augmented by the addition of the comet's heat to his own store." He gives instances where comets have passed very close to us without perceptibly increasing the heat of our atmosphere.

He next inquires how much heat will be generated, supposing a comet were to fall into the sun by the sudden conversion of its *vis vivâ?* He shows that supposing the velocity of the comet to have been 300 miles per second, then every 1 lb. of its mass would liberate heat enough to raise 126 tons of water from the freezing- to the boiling-point. But what will be the weight of a comet? Here authorities differ. Sir John Herschell thought "a few pounds." The author thinks it "improbable that the whole thing has a mass much greater than a few tons," whilst Professor Pierce argues that the nucleus of the comet of 1843 must be of metallic density, and consequently that its mass must amount to thousands of tons.

The meteoric train which the "Doomed Comet"—like every other body of its class—draws after it, is estimated at 200,000,000,000,000,000,000 lbs. Were this quantity of matter suddenly plunged into the sun, the heat evolved would be sufficient to raise the temperature of a sphere of iron of the size of the earth to 1450° C. above its melting-point. Such a liberation of heat would doubtless affect the radiation of the sun. But from considerations laid down it is probable "that the comet must be swallowed up piece-meal, the whole operation occupying not years but possibly centuries."

Turn we now to a consideration of the effects of increased solar activity upon the earth. The presence of sun-spots has for more than two centuries been supposed to influence the weather. But concerning the nature of this influence the learned are not agreed. Some have held that a spotty sun portends cold and wet; whilst others maintain that it causes fruitful seasons. An increasing attention has been given to the subject since Wolf, of Berne, discovered the sun-spot cycle of eleven years, and concluded that when spots are plentiful the seasons are warm and dry, but when the sun is spotless they are cold and wet.

The author does not dispute the connection of this cycle with the occurrence of magnetic storms and auroræ. But he is sceptical as regards its influence upon hot and cold seasons, cyclones, storms and gales, wet and dry seasons, frequency of hail and thunder, earthquakes, famines, pestilence, political agitation, the sweating sickness, the potato disease, commercial crises, and shipwrecks. He reminds us that Gautier, from observations embracing Europe and America, came to a conclusion precisely opposite to that of Wolff, whilst Dr. Jelinck, from observations embracing the whole world, shows that no conclusions at all can be drawn. He remarks: "Statisticians, like the late Stanley Jevons, Mr. W. W. Hunter, and others, took it for granted that a connexion between the number of sun-spots and our meteorological conditions was established when nothing of the kind had been done. They constantly said 'meteorologists tell us' so and so, and then proceeded to argue upon the basis of Lockyer and Company's statements. Shaky foundation! Mr. Cornelius Walford's chronology of famines has effectually disposed of the famine cycle, and works of a similar nature would soon demolish the others." He adds in a note that Mr. Walford is preparing a chronology of plagues.

In fact there is an open and palpable difficulty in the way of these cycles as far as the weather and the crops are concerned. Different parts of the same hemisphere, and even of the same continent, are differently affected. During the past summer, western Europe, as far as Italy, Switzerland, and western Germany, inclusive, has suffered from cold and wet, whilst Hungary, Russia, and the Balkan Peninsula, have basked in sunbeams, and enjoyed a harvest so bountiful that much of it has been left ungathered!

In conclusion the author expresses his belief that the British Isles and western Europe will be affected in such a way as to induce warmer and drier weather. This prophesy, as far as the British empire is concerned, is largely tempered with evil, for he goes on to say that "the opposite conditions may be expected to prevail in India, Australia, and North America."

The Mind in the Face; an Introduction to the Study of Physiognomy. By W. McDowall. London: L. N. Fowler. Edinburgh and Glasgow: Menzies and Co.

That character, ability, and all that is included under the term "mental disposition," are to some extent shown in the face, is an opinion of venerable age. Like many such opinions it contains an element of truth which deserves candid appreciation, elimination from accompanying errors, and careful culture. Hence the work before us has a legitimate object, and merits public attention. It would obviously be no small gain to the world if those peculiarities of the features in which every man differs more or less from every other man could be found to be —in mathematical phrase—*functions* of the equally endless varieties of character.

Many an upright man would find his path smoothed, and many a villain would be brought to an unexpected check in his career, if his inward nature could be even approximately read by his neighbours.

But this problem is admittedly difficult. All observers must admit that there are, on the one hand, persons whose dispositions or aptitudes—whether good or evil—are readily apparent, whilst, on the other, there are those whom we pronounce inscrutable. "What do you think of Mr. X?" "I can't make him out." Who has not heard this question and reply?

The author of the treatise before us fully admits that physiognomy is fragmentary, and that its chief exponent, Lavater, "never aspired to the honour of building up a complete system." For such a task, indeed, he was not the man.

Mr. McDowall seems to some extent to consider that our physiognomic insights into character are based more upon "instinct" than upon reason. He writes :—"Children, though unable to reason upon the subject, are guided by it in their likes and dislikes ; and we doubt not the lower domestic animals, unenlightened by Lavater, are yet guided by the science which he taught. Burns could not have made his canine friends, Luath and Cæsar, dogmatise so finely about the lords of the creation had they not been able to read the language of the human face."

Here, however, we are reminded of an error which the author, if he does not share, still does not distinctly repudiate. Many of those persons whom our contributor Frank Fernseed terms "Cynolaters," and especially certain lady-novelists of the "Ouida" school, are given to hint that dogs attach themselves to good men, and instinctively avoid bad ones. How this opinion can be for a moment upheld in face of the palpable fact that poachers, sheep-stealers, roughs, and criminals generally are on the best of terms with dogs, is hard to explain.

But in support of the "instinctive" view it may be remembered that our first impressions of the character of a stranger to whom we have just been introduced are often more trustworthy than the careful estimates which we form on prolonged observation. Especially is this the case with dislikes. Many a person has bitterly rued overruling such dislikes as uncharitable.

Mr. McDowall does not set about his task in a perfectly systematic manner. He gives the portraits of certain historical personages, and indulges in rather rhapsodical descriptions of their powers. Thus anent the first Napoleon he introduces from Victor Hugo's "Les Miserables" (Chap. XII.) a quotation extending to nearly two pages ; this in a work which does not reach in all ninety pages. We have, in like manner, long dissertations on George Whitfield, on Martin Luther, on Robert Burns, and on Shakspeare. Persons of our own day, whose features might be more easily compared, if not with their characters, yet at least with their actions, are but sparingly introduced. Mrs. Fletcher and Mrs. L. N. Fowler are scarcely so well known that the public can of their own judgment compare features and character.

In addition to these ladies we find merely the Queen and Mr. Jos. Chamberlain, M.P., for Birmingham (!), neither of whom, especially the latter, can be discussed in a non-political journal. To us, at least, it is a great disappointment that the author has avoided the examination of any scientific character, whether of the past or the present. It would, to us at least, have been deeply interesting to hear his estimate of Aristoteles, of Galilei, of Harvey, Newton, or Darwin, as deduced from their portraits.

We should recommend those who have the inclination and the aptitude—including, of course, a quick eye and a good memory for forms—for physiognomic observation to apply and test the author's rules in studying the features of their acquaintances.

The Science of Home Life: a Text-Book of Domestic Economy. By W. JEROME HARRISON, F.G.S. First Year's Course. London, Edinburgh, and New York: T. Nelson and Sons.

WE have here the substance of lessons which have been given in the girls' schools belonging to the Birmingham School Board. The experiment of such teaching in elementary schools is, we believe, somewhat novel, and may possibly in certain quarters be looked upon with suspicion. We see no reason for any such feeling. There is nothing here but the plainest exposition of facts which every girl, and boy too, of whatever rank in life, decidedly ought to know. Unfortunately a large part even of our adult population are ignorant of much which is here set forth, and has to suffer in consequence both in the pocket and in health.

The treatise before us in some respects will remind the reader of Johnston's "Chemistry of Daily Life," and of Lewes's "Physiology of Common Life." But the information given is necessarily much more concise and simple in its form than that which is afforded by the favourite works above mentioned.

To a few passages exception may, perhaps, be taken. Thus, it is scarcely proved that diamond would result from the fusion of carbon. Nor has it ever been demonstrated that the proportion of carbonic acid contained in the air is absolutely constant and does not increase. This point, indeed, can scarcely be decided for some centuries to come.

In the paragraph on ventilation (p. 37) it would have been useful to add that air which has been breathed contains other matters besides an increased amount of watery vapour and carbonic acid. On p. 64 we read: "As the finely-divided fat passes down the small intestines it is squeezed through their sides into certain small tubes, which carry it to the blood vessels." "Squeezed" is here by no means a happy expression for the process which takes place. We find the same word used on p. 76.

Exception may, perhaps, be taken to the statement that milk is a natural beverage. It seems scarcely natural for a non-ruminant animal like man to drink a secretion elaborated for the nurture of calves. The remarks on the adulteration of milk contain an unfortunate omission. It is stated, justly, that milk is heavier than water, but the author has overlooked the equally well-known fact that skimmed milk is heavier than new milk. Hence the lactometer is useless as a milk-test. A rogue may skim the milk and add a certain quantity of water, and yet the mixture thus obtained may give, with the lactometer, the same results as pure milk. It would be a good moral lesson if children were taught to regard the adulterating tradesman as standing precisely on the same level as the thief. A public opinion might thus be created which would demand much more efficient punishments for sophistication. Mr. Harrison might, we think, with advantage have briefly called attention to the evils resulting from the use of patent or proprietary "foods" as nutriment for children. These mixtures are grossly deficient in the blood-forming elements of food, and the amyloid matter they contain is a cheap starch, which young children are unable to digest and assimilate. Medical friends of large experience inform us that when they meet with an ill-nourished, feeble child, they generally find that it has been fed on some advertised "food" or "flour." All persons who are wise enough to see the importance of so-called little things will agree with us that if such lessons were generally instilled into the young, within a dozen years the nation would be re-modelled, and not a few grievous evils would find their end approaching.

Records of the Geological Survey of India. Vol. XV., Part 3, 1882.

THIS issue is mainly devoted to reports on various Indian coal deposits. We have notes on the coal of Mach in the Bolan Pass, and of Sharag, or Sharigh, between Sibi and Quetta, by W. T. Blanford, F.R.S., whose opinion concerning both localities is unfavourable.

Mr. F. R. Mallet, F.G.S., describes splendid specimens of zeolites discovered in the trappean rocks of the Bhor and Thul Ghâts, the species chiefly represented being stilbite, apophyllite, heulandite, and scolecite.

Col. C. A. McMahon, F.G.S., reports on the traps of Darang and Mandi, in the North-western Himalayas; whilst Mr. A. B. Wynne communicates a note on the connection between the Hagara and the Kashmir series.

Messrs. T. W. H. Hughes, T. D. La Touche, and R. Romanis report respectively on the coal-fields of Umaria, Darangirri, and Myanoung. The Umaria coal is of fair quality, easily accessible, and the bed being of the average thickness of 14 feet the quantity available, at the depth of 300 feet from the surface over the

3 square miles examined, is estimated at 28 million tons. At Darangirri there is, in the area of 20 square miles forming the western half of the field, an available quantity of 76 million tons. At Myanoung, in British Burma, the explorations are not complete, but there is a coal-bed of the thickness of 10 feet, and there are bituminous shales, possibly indicative of petroleum.

On the Quartzite Pebbles contained in the Drift; and on their Derivation from an Ancient Land Barrier in Central England. By W. Jerome Harrison, F.G.S. With a Note by J. J. H. Teal, M.A., F.G.S. (Reprinted from the "Proceedings of the Birmingham Philosophical Society," vol. iii., p. 157). Birmingham: Herald Press.

The author describes the lithology of the pebbles in question, the fossils which they contain,—chiefly Brachiopods, Lamellibranchs, Crustacea, and Annelida, and their derivation. He shows that they are derived from the pebble-bed or conglomerate which forms the middle member of the Bunter Sandstone, or Lower Trias. He considers that the pebbles in question are among the evidences of an ancient ridge which ran across Central England, and during the Carboniferous times formed a barrier between the coal-fields of Leicestershire, Warwick, and South Stafford to the north, and those of Gloucester and Somerset to the south. This ancient land axis crops out in a line of points from the Malverns, running by the Caradoc, the Wrekin, the Lickey Hills, Dosthill, and the Hartshill Range, to Charnwood Forest. Mr. Harrison considers that this range once formed a coast line washed by the waters of the "Midland Channel," and that the pebbles have been thus rounded by marine action.

Mr. Teal, in an Appendix, discusses the microscopic structure of specimens of quartzite collected by Mr. Harrison from the Lickey Hills, Nuneaton, &c. He concludes that these quartzites were originally sandstones, which have been converted by the deposition of secondary quartz. They have certainly not originated by partial fusion.

Elementary Mechanics, or First Lessons in Natural Philosophy. By W. Jerome Harrison, F.G.S. London: T. Nelson and Sons.

This little work is the substance of a series of lessons which have been delivered in the schools of the Birmingham School Board. The author's method is simplicity itself: he takes some common object, or some familiar instrument, and contrives to illustrate and enforce by its means important lessons in physics. For a more formal proceeding the pupils have scarcely the time, nor would their attention be so easily arrested. But this method is, after all, that of true Science. It has been said by a very high authority that—*e.g.*, in teaching botany—we must begin with the plants, and then refer to books to co-ordinate the knowledge which has thus been drawn direct from the fountain. The same holds good in every department of Science.

We are certainly of opinion that what England really needs, if her industrial position is to be maintained, is improvement in her system of secondary rather than of primary education. Nevertheless we believe that such teaching as the work before us aims at imparting will have a salutary effect.

American Journal of Mathematics. Published under the auspices of the Johns Hopkins University. Editor-in-Chief: J. J. Sylvester. Associate Editor: W. E. Story. Vol. III., No. 4.

This issue contains memoirs by Mr. O. H. Mitchell on "Binomial Congruences"; on "Linkages for X^m," by F. T. Freeland; on "The Strophoids," by W. Woolsey Johnson; on the "Ratio between Sector and Triangle in the Orbit of a Celestial Body," by Ormond Stone; on "Centre of Gravity of Surface and Solid of Revolution," by E. W. Hyde; on a "Point in the Theory of Vulgar Fractions," by J. J. Sylvester; on an "Immediate Generalisation of Local Theorems in which the Generating Point divides a Variable Linear Segment in a Constant Ratio," by Samuel Roberts; on the "Expansion of $\phi(x+h)$," by A. W. Whitcom; on the "Theory of Rational Derivation in a Cubic Curve," by W. E. Story; and "Instantaneous Proof of a Theorem of Lagrange on the Divisors of the Form $Ax^2+By^2+Cz^2$, with a Postscript on the Divisors of the Functions which Multisect the Primitive Roots of Unity," by J. J. Sylvester.

CORRESPONDENCE.

*** The Editor does not hold himself responsible for statements of facts or opinions expressed in Correspondence, or in Articles bearing the signature of their respective authors.

ANCIENT "CUPS AND RINGS."

To the Editor of the Journal of Science.

Sir,—In a contribution on " Stone Circles and their Relation to Outlying Stones or Tumuli on Neighbouring Hills, &c. (" Report Brit. Assoc.," 1881, p. 697), Mr. A. S. Lewis affirms, " from an examination of eighteen stone circles in Southern Britain," it was " shown that their builders had in various ways made special reference to different points of the compass, *but most particularly to the N.E.*" This information was extremely interesting to me, as about a year ago I had, from personal observation, noticed that the grooves connecting or going forth from the cups and rings on the celebrated groups of stones near the village of Ilkley, in Yorkshire, were generally axially in this direction, *i.e.*, N.E. (*see* Whitaker's " Craven," p. 289), " probably the most important group of archaic sculptures in England." One cannot help, however, regarding these with suspicion, because the hand of one of those silly weak-minded individuals (whom it would be both a service and a pleasure to kick into the nearest asylum) has been at his sacrilegious work of desecration here, at least in one instance (shown not only by its clumsy execution, but being on a ground where the rock has only comparatively recently been split off). On the stone containing the best examples there are indications of an older set below—a suspicious circumstance. However, I feel pretty sure that they have a N.E. direction (20° N.E. ?); and perhaps the cups alone, where the rings have been obliterated by time, may be said to point in the same direction. I have seen none pointing any way but northwards.—I am, &c.,

D. Y. C.

Linnburn.

THE ‘SULPHUR THEORY” OF FOGS.

To the Editor of the Journal of Science.

Sir,—The fog-season having again come round, and found us practically as open to its attacks as we were ten years ago, you will perhaps permit me to ask whether the fashionable theory of its origin is well-founded? If we make careful observations we find that fogs have very well-marked local boundaries which are often found to be the same year by year. Can it be for a moment supposed that these boundaries mark out constant differences in the chemical composition of the air, sulphur being present on one side of the line and absent on the other?

Eight years ago I remember a fog which overspread all London, being as opaque in Holloway, Camden Town, Westminster, and Hackney, as in the City, I happened to be going in the afternoon to Chingford. When past Hale End the train suddenly dashed out into clear air and bright sunshine. On looking back, either to the right or left hand, the fog lay sharply cut off like a fleecy wall, and seemed to be constantly recruited by vapour which rose up like smoke from among the clods of the ploughed fields. Is it likely that sulphur was the acting cause of fog in a neighbourhood so free from houses as the country between Hale End and Chingford? Sulphur fumes cannot have been brought by the wind from London, for what little current was perceptible in the air was in the opposite direction. Had such fumes been brought, would not their influence have gradually faded away instead of being abruptly cut off?

As a somewhat similar phenomenon to the abrupt termination of fogs I may mention abrupt breaks in the clouds, which, though not constant, are very frequently observed in some particular quarter of the heavens. Years ago, when living at Gorton, a village south-east of Manchester, I very often noticed that when the sky was clouded overhead and in all other directions, there was low down, near the horizon, bright sky visible to the south-west, as if it might be over the estuary of the Dee. Such breaks seemed independent of the direction of the wind, and remained without change for hours.—I am, &c.,

Sky-gazer.

'NUTS FOR MATERIALISTS."

To the Editor of the Journal of Science.

Sir,—In one of your contemporaries, with which you seem to be on amicable terms, I find two incidents recorded under the title above quoted. In one case a ship-owner, who had insured his vessel and cargo, dreamed that he saw it wrecked at a certain point, in consequence of the drunkenness and neglect of the captain. So convinced was he that the accident would really occur that he actually "chaffed" the underwriters about the loss which they would experience. It is added that in time the ship was actually wrecked, at the very place and under the very circumstances, represented in the owner's dream.

Now I do not dispute that such incidents, if truthfully narrated, are "nuts for the Materialist." But I submit that they are no less nuts for the Animist. We are utterly unable to understand on what principle spiritual being, if such exist, should be capable of foreseeing future events more than a material being. Can the absence of such properties as extension, weight, impenetrability, &c., confer such powers?—I am, &c.,

A Lucretian.

DOCILITY AND ATTACHMENT IN A DUCK.

To the Editor of the Journal of Science.

Sir,—At Finchley there is now living a duck which is exceedingly attached to the daughter of its owner. If she goes into the garden the bird comes waddling to meet her. She takes it up in her hands, caresses it, and throws it up in the air, when it flies round and round her for several times, and then returns to her feet. Instances of personal attachment among water-fowl being rather rare, this fact may possibly be of interest to some of your readers.—I am, &c.,

H. S.

The subjoined letter originally sent to a contemporary having been ignored, it has been forwarded to us by the writer :—

MR. DARWIN AND PROFESSOR HAECKEL.

To the Editor of ———.

Sir,—May I hope that you will not object to insert in an early No. of ——— the following respectful remonstrance and explanation with reference to your remarks of November 10th, on the letter of June 5th, 1879, written by the late Mr. Charles Darwin, in answer to Baron Mengden, as recently published by Professor Haeckel, of Jena ?

Your remarks, to which I beg to direct your attention and that of your readers, are the following :—" One scarcely knows which most to wonder at, the impertinent curiosity which elicited the letter or the bad taste which led to its publication. If we were not assured that every reader of ——— has already seen the letter, we should not now publish the correct form ; for a man's views on such matters are no concern of others unless he himself chooses to publish them."

Surely, Sir, on mature reflection you will be inclined to modify this harsh judgment, and to ascribe the letter of the Baron to far other motives than those of impertinent curiosity. The feelings which dictated his appeal to Mr. Darwin were self-evidently those of an " anxious inquirer " seeking an authoritative solution of perplexity and doubt. Natural Science—in its very inception sceptical—has necessarily the most unsettling effect on minds educated in the vulgar " Creed of Christendom " and in a belief of Supernatural Revelation. And in this Age of Unfaith or Scepticism it seems as natural and becoming to consult scientific hierophants like Mr. Darwin on matters which now constitute the burning problem, both in speculation and politics, of our epoch, as it was in the *pre-scientific* " Ages of Faith " to sit at the feet of approved Confessors of Theology. "*Nullius in verba*," &c., is no doubt the perfect canon in scientific research, but this perfection cannot with justice be expected from an immature scientific tyro in his *Lehrjahre*, being a hard-won privilege of the matured *Meisterwürde.*

I feel quite satisfied that neither Baron Mengden nor Professor Haeckel were at all actuated by the unworthy motives with which you credit them, and such I feel convinced will be the all but general verdict of impartial public opinion in their favour.

Before concluding I may, without violation of any confidence, mention that, both *viva voce* and in writing, Mr. Darwin was much less reticent to myself than in this letter to Jena. For, in an answer to the direct question I felt myself justified, some years since, in addressing to that immortal expert in Biology, as to the bearing of his researches on the existence of an "*Anima*" or "Soul" in Man, he distinctly stated that, in his opinion, a vital or "spiritual" principle, apart from inherent somatic energy, had no more *locus standi* in the human than in the other races of the Animal Kingdom—a conclusion that seems a mere corollary of, or indeed a position tantamount with, his essential doctrine of human and bestial identity of Nature and genesis.—I am, &c.,

Robert Lewins, M.D.

CHEMICAL THEORY OF APPARITIONS.

To the Editor of the Journal of Science.

Sir,—The chemico-physiological hypothesis suggested in your issue for November (p. 692), in explanation of ghost-seeing, &c., reminds me of a letter I once met with in your correspondence pages (1880, p. 279), an account of a room in which few persons could sleep without being attacked with nightmare. The letter was headed "A Difficulty to Solve." Have we not here a possible solution ?—I am, &c.,

Old Subscriber.

NOTES.

Some years ago an improvement upon the old oxy-hydrogen microscope, by Mr. John Browning ("Quarterly Journal of Science," vol. vii., p. 285) was noticed in this journal. The "Journal of the Royal Microscopical Society" for October (p. 673) contains an abstract of a paper by Dr. Hugo Schröder on "Projection Microscopes," with a description of an instrument, constructed by himself, with which it is stated a power of from 100 to 2000 can be obtained, the source of illumination being an ordinary petroleum lamp: a figure of the instrument accompanies the abstract. The perfecting of such microscopes would be a desideratum, as at present the only known mode of exhibiting magnified objects on a screen to many spectators, in a manner at all satisfactory, is by the enlargement of photographs by means of a good lantern. It is to be hoped that English and foreign opticians may be able to effect further improvements.

The same journal (p. 726) quotes Prof. C. H. Kaid ("Amer. Monthly Micro. Journ.," iii., 1882, pp. 71-2) on the advantages offered by the recent improvements in dry-plate photography to the microscopist. Of dry plates it states:—

"1. They can be kept for any length of time, and used as occasion requires.

"2. If not convenient to develope the plate at the time the exposure is made, it can be put away and developed at leisure, even after an interval of weeks.

"3. No dangerously poisonous chemicals are necessary in the developing process.

"4. They are so sensitive that the light of an ordinary kerosine lamp is amply sufficient to photograph objects with all powers not higher than ½-inch objectives. Probably a ¼-inch objective could be used by properly arranging a system of condensers."

At a meeting of the Camden (U.S.A.) Microscopical Society Mr. J. Carbutt took a negative from a spider's foot with a 2-inch objective and an exposure of 2 minutes, and from a sheep-tick with an exposure of 1¼ minutes, the shorter exposure being due to the object being much less dense and yellow.

The Netherlands Scientific Society of Haerlem offers prizes for essays on the structure of the kidneys of the Mammalia, on the peripheric nervous system of the various osseous fishes, and for a history of the development of one or several species of the Lamellibranchiæ. The essays must be sent to the Secretary of the Society prior to January 1st, 1883.

One Roald Arentz, of the State of Connecticut, has applied for a British patent for "an invention of Cosmie, being the name for gathered energy of that force which in its normal existence eventuates gravitation."

Archdeacon Colley, of Natal, is suffering under an attack of anti-vaccinationism of the most virulent type.

The "Medical Press and Circular" gives a searching review of Mr. Lawson Tait's "Uselessness of Vivisection."

Certain correspondents of an influential Scottish paper have revived the tradition that horse-hair, thrown into water in warm weather, turns into eels.

Mr. T. K. Taplin ("Light"), writing on the subject of the "divining-rod," ventures to say that "the labouring men born and bred in any district know well the nature of the land, and where water is to be obtained." How is this possible unless mining or well-sinking operations have been carried on?

According to the "Scotsman" an electric boy is being exhibited in the Waverley Market, Edinburgh. The touch of his hand produces a sensation like that produced by an electric current, and with the tip of his tongue he can give a smart shock.

The preservative injection of Dr. Tounletti, by which animal bodies may be preserved in a fresh state for an unlimited time, has been found perfectly successful, but its composition is still a secret.

Prof. G. H. Cook, in a paper read before the American Association for the Advancement of Science, contends that the entire Atlantic coast of North America, from the Carolinas to Greenland, is subsiding. He thinks that the same change is occurring over the whole Northern Hemisphere.

The memorial to the late Prof. Balfour has taken a double form: there will be created a Studentship of the value of £200 per annum, the holder of which is to devote his whole time to original research in biology, more especially in animal morphology, and also a fund out of which occasional money grants will be awarded to further research in the same science. This is better than a statue.

Will there be no "Darwin" Studentships, Fellowships, or Professorships founded?

MM. Dehérain and Maquenne ("Comptes Rendus") find that soils which have been heated to 248° F., or have been exposed to the vapour of chloroform, cease to reduce nitrates.

Prof. John Milne ("Geological Magazine") calls attention to the tremors and oscillations of the earth as demanding closer and more extended observation.

In the same journal the Rev. O. Fisher cites the depression of ice-loaded lands as evidence that the earth cannot be rigid from the centre to the circumference.

May not the polar flattening of the earth be due not so much to the effects of centrifugal force as to the pressure of the Arctic and Antarctic ice-caps?

It is not generally known that the late William Howitt was one of the leaders of the Bestiarian movement. He it was who first termed physiological experiments "orgies of diabolism."

M. Couty, in a communication to the Academy of Sciences, shows that curare is not merely a paralysing poison, but has in the first place a slightly convulsive action. It is also not only a peripheric poison, but to a certain degree affects the nervous centres.

The Birmingham and Midland Institute is generally supposed to be a technological and scientific organisation. To judge from the speech of its President, Mr. J. A. Froude, it would seem to be rather a political club. Or, possibly, the distinguished speaker slightly mistook his locality.

M. E. L. Trouessart ("Comptes Rendus") has observed earthworms of the common species, *Lumbricus agricola*, constructing towers exactly like those described by Darwin in his last work as being constructed by a worm of the genus *Perichæta*, which has become naturalised in the neighbourhood of Nice. The anterior part of the worm's body is generally lodged in the tower. The author's observations have been principally made at the Botanical Garden of Angers.

According to "Light" Mr. E. Gallagher, of Greenfield's Villa, Heaton Chapel, near Stockport, "has given abundant proof of his seeing persons, places, and events thousands of miles away, and of ability to foresee events with great accuracy long before their literal fulfilment."

An important deposit of coal, accompanied by beds of fine white sand, has been discovered at Bou-Saada, in Algeria.

In the department Alpes Maritimes the application of carbon disulphide along with potassium sulpho-carbonate to the phylloxerised vineyards has proved decidedly successful. The vines have not been injured.

According to M. L. F. Nilson ("Comptes Rendus") the specific gravity of pure thorium is 11·00, and its atomic weight (supposing it to be quadrivalent) 232·43.

Prof. Joseph Le Conte (California Academy of Sciences) discusses certain fossil foot-prints observed in Nevada which seem due to a biped, either a man or an anthropoid ape.

A scientific friend asks whether the phenomena known as "thought-reading" may not indicate the dawning of a novel faculty which, in the course of perhaps a hundred generations, will become too plain to be questioned?

Dr. Quinlan aptly remarks that "In Germany medical science is honoured and decorated instead of being hunted into foreign countries by Anti-Vivisection Acts."

Senhor Lopez Netto has met with a "lignified" snake (Jaracara) in the crack of a tree in Matto Grosso. The animal appears to have died in the crevice, and in the course of its decay each particle of animal matter was replaced by a particle of woody tissue deposited by the cambium. The process is thus quite analogous to that of fossilisation.

Prof. Virchow maintains that it is not the province of Science to attack faith or its objects, but it is her duty to mark and consolidate the present boundaries of knowledge.

Mr. F. A. Lucas, after careful examination, decides that there is only one species of *Mias*.

M. Felix Plateau ("Acad. Roy. de Belgique," 1882, p. 727) has made some interesting experiments on the respiration of insects. He finds no direct relation between the form of the respiratory movements of an insect and its place in our zoological classification. In all insects the vertical diameter of the body decreases during expiration. A lateral contraction is observed only in certain groups. A supposed wave-like progression of the respiratory movements is perceptible only in isolated forms of some groups. Inspiration is ordinarily much slower than expiration, the latter being often abrupt. Most insects possess merely expiratory muscles, inspiration being effected chiefly by elasticity of the tracheæ. Muscles which aid in inspiration are found not only in the Hymenoptera and the Acridiidæ, but also in the Phryganeæ. The respiratory movements are of a purely reflex character. The metathoracic ganglia are not specially respiratory centres.

According to the "Naturforscher" H.H. Erlenmeyer and Lipp have effected the synthesis of tyrosine, a compound hitherto obtained exclusively from animal matter.

Herr von Liebenburg ("Wiener Akademie") suggests that lime plays an essential part in the formation of vegetable protoplasm.

"Les Mondes" gives an account of a case of malignant tumour on the cheek of a man, produced by the bite of a large black fly which was killed in the act. The pustule was cauterised, and the patient took internally, in twenty-four hours, 500 grms. Spanish wine, 300 grms. rum, and 200 grms. Chartreuse, without experiencing the least symptom of intoxication.

Mr. T. Taylor, in a paper read before the American Association, has experimentally proved the house-fly to be a distributor of poison-germs. (We may return to this subject.)

We are happy to welcome Prof. Pettigrew, F.R.S., as an able combatant against cram and examinationism. In an introductory lecture in physiology, at the University of St. Andrews, he is reported to have said :—"The ancients believed, and he thought rightly, that men varied as to intellectual capacity and endowment, and that it was the province of education to draw out of the man that which naturally inhered in him. The more modern —and he believed the less philosophic—view takes for granted that men vary little to begin with, and that everything might be put into them by a process of cramming. The ancients aimed at teaching men to think and judge ; the moderns had no soul above passing examinations and getting on in the world. As a physiologist, his sympathies were wholly with the ancients. The great problem of the day was how to develope and cultivate the human intellect. The two great modern schools of education were, he said, widely divergent. The one sought, by symbol and cipher, to impart to the young and inexperienced head abstract ideas and truths about men and things ; the other aimed at instructing youth not by symbols and the mere names of things, but by the things themselves—these, fortunately for Science, being strewn around in prodigal profusion. The former method —the symbol teaching—leans principally upon memory, and is eminently unattractive to the young mind. It has, as a consequence, proved a comparative failure. The latter method—the object lesson method—is quite a seduction for children ; it leans less, indeed comparatively little, on memory, and provokes thought and reflection. The object lesson method expands the reason, and developes and corrects the judgment."

M. Burcq (" Comptes Rendus ") shows that copper has a powerful disinfective and antiseptic action. Artisans who work with this metal enjoy an almost absolute immunity from cholera and typhoid fever.

M. Joyeux-Laffuie has carried out observations on the poison-apparatus and the poison of *Scorpio occitanus*. He finds that this poison, though less deadly than is commonly inserted, is very active. A single drop injected into the cellular tissue of a rabbit proves rapidly fatal. The same quantity suffices to kill seven or eight frogs. Fishes and mollusks are more refractory, but the Articulata are exceedingly sensitive. One-hundredth of a drop of the poison immediately kills a large crab. The poison acts upon the nerve-centres, and produces first excitement and afterwards paralysis.

Mr. Herbert Spencer, before leaving America, is said to have pointed out very emphatically the racial degeneracy which overwork is bringing upon the American people.

The honours of the Royal Society have been thus awarded:—The Copley Medal to Prof. Cayley, F.R.S., for researches in pure mathematics; one of the Royal Medals to Lord Rayleigh, F.R.S., for researches in physics; the other Royal Medal to Prof. W. H. Flower, F.R.S., for discoveries in the morphology and taxonomy of the Mammalia, and in anthropology; the Davy Medal in duplicate, to Prof. Mendelejeff and Prof. Lothar Meyer, for researches in the periodicity of atomic weights; and the Rumford Medal to Capt. Abney, F.R.S., for researches in photography.

M. G. A. Hirn ("Comptes Rendus") combats the new theory of the sun put forward by Dr. C. W. Siemens. He shows that the return of the elements to the centre would not contribute to the continuous reproduction of the solar heat.

MM. Etard and L. Olivier ("Comptes Rendus") have conducted researches on the reduction of sulphates by species of *Beggiatoa*, *Oscillaria*, and *Ulothrix*. Plants belonging to the first-mentioned genus do not flourish in waters devoid of sulphates.

M. Feltz, in a communication to the Academy of Sciences, proves that earthworms living in a soil saturated with the infectious matter of "charbon" are capable of propagating and distributing the disease.

M. D. Klein proposes the following modification in the statement of the law of isomorphism:—Isomorphous bodies have either a like chemical composition or present a centesimal composition, differing but slightly, and always containing a group of elements common or of identical chemical functions, and forming much the greater part of their weight.

M. Pouchet has communicated to the Academy of Sciences on the evolution of the *Peridinia*, and on the peculiarities of organisation which connect them with the Noctilucæ.

A correspondent of the "Field Naturalist" calls attention to a tradition that "young robins annually kill their parents during the autumn months."

MM. J. Moursin and Schlagdenhauffen ("Comptes Rendus") have experimented on the fluids of the Sea-urchins, of the cysts of Hydatids and of the Cysticerci, and, lastly, of the Amniotic fluid. All these liquids contain a ptomaine. The fluid of the large water-vessel of *Cysticercus tenuicollis* is distinctly venomous, and when injected into the peritoneal cavity of rabbits occasions death, with symptoms indicating the decomposition of the blood.

It appears that the cuckoo-cry *cui bono ?* in reference to scientific research, after being abandoned by the economists and the utilitarians, has been taken up by the ethicists. Dr. J. Burdon-Sanderson, F.R.S., justly says concerning this question—" From their point of view it does not admit of an answer ; from mine it does not require one."

Our attention has been called to the subjoined passage in a somewhat heterodox journal. The writer, a lady, declares that Science, " in arriving at its conclusions and in the forth-putting of its power, is, in many instances, wantonly cruel, unscrupulously reckless, and highly immoral. In too earnest zeal, however, to overthrow ecclesiastical dogma and priestly domination, we forget that, in the vivisection of living animals, in compulsory vaccination, in imperfect drainage, in bad house construction, in the devising of monstrous instruments of war, in the snapping of cheaply-constructed bridges, in the manufacture of slipshod goods, in the use of benumbing poisons for sensual and criminal purposes, in contriving and using infernal machines, Science is working subtly and dangerously, and that the evils of unconsecrated knowledge are far more dangerous and degrading than the evils of ignorance and superstition." An author who can consider Science to blame for " imperfect drainage, bad house construction, &c.," may almost be excused for being an anti-vivisectionist. Science does not devise, construct, manufacture, or use ; her sole task is to perceive, to understand, and to declare.

According to MM. Weber and Guldensteeden-Egeling (" Pflüger's Archiv.," xxviii., p. 576) a myriapod belonging to the genus *Fontaria*, found in conservatories in Holland, has the remarkable property of secreting hydrocyanic acid.

According to M. Viguier (" Revue Internat. Sciences Biolog.,") a number of carrier pigeons belonging to the Société Colombophile de la Loire were successively thrown up at Grand Croix, at Montelimart, Avignon, and Marseilles. Those which found their way back were then taken to Algiers, and thrown up there. Not one found its way back to Saint Etienne.

The Fourteenth Meeting of the Royal Commission on Technical Instruction was held on the 25th and by adjournment on the 26th of October, at the South Kensington Museum. Present —Mr. B. Samuelson, M.P., F.R.S., in the chair ; Dr. Roscoe, F.R.S., and Messrs. Magnus, Slagg, M.P., Swire Smith, Woodall, M.P., and G. R. Redgrave (Secretary). The Commissioners discussed their future visits to educational institutes in this country, and made arrangements for the examination of the officials of the South Kensington Science and Art Department.

The evidence of Colonel Donnelly, the Assistant-Secretary and Director for Science, was then taken, and that of Sir P. Cunliffe Owen, K.C.M.G., the Director of the South Kensington Museum, and Prof. Huxley, F.R.S., was to follow.

At the suggestion of several friends in Cornwall Mr. Quick is about to re-publish, in one volume, by subscription, his historical and descriptive Essays on the Mining, the China Clay Trade, and the Pilchard Fisheries of Cornwall, which have from time to time appeared in the "Journal of Science," "Fraser's Magazine," and other periodicals. These Essays trace the earliest records of Cornish mining, describe the old Stannary Parliaments, deal largely with the peculiar characteristics and strange superstitions of the old miners and fishermen, and give a vast amount of other information respecting Cornish industries. Price to subscribers 4*s*. 6*d*., which should be sent by Post-Office Order to Eastern District Post-Office, London, to Mr. Jas. Quick, 11, Agnes Street, Burdett Road, London, E.

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